TECHNICAL MEMO 74-13

ACOUSTIC LOCATOR SYSTEM: TEST RESULTS FOR THE UH-1 AND AH-1G

by

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Test results are presented for an airborne device called the Acoustic Locator System for detecting and locating the source of small arms fire directed at the UH-1 and AH-1G helicopters. The Acoustic Locator is considered usable on the UH-1, but not usable on the AH-1G.

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INTRODUCTION

The Acoustic Locator System is a device intended to detect and locate the source of small arms ground fire directed at Army helicopters. The system was first developed by Westinghouse Defense and Space Center under Contract DAAD05-67-C-0040 (Final Report titled: "Acoustic Locator System," Sept 67. AD 390885L) and then under Contract DAAD05-68-C-0227 (Final Report titled: "Improved Acoustic Locator System," Sept 69, AD 861-337L). The above two reports describe the development and operation of the systems. This report describes the tests of the Improved Acoustic Locator for the UH-1 and Cobra (AH-1G) aircraft.

In 1967, seven of the first Acoustic Locator Systems were evaluated in Vietnam by the Army Concept Team in Vietnam. The systems were found to be potentially useful but several improvements were suggested. These improvements were made and the resulting Improved Acoustic Locator Systems are discussed in this report. The Vietnam situation was changing and the Improved Acoustic Locator System was never evaluated in Vietnam. It was, however, tried on a Cobra, AH-1G, aircraft and found to be unsuitable for the Cobra aircraft because of the speed and noise level of the Cobra (Appendix B). In 1971, the improved Acoustic Locator System was evaluated by MASSTER, Ft Hood, Texas and the results are reported in MASSTER Report "Improved Acoustic Locator Systems Test Report, Volume II," March 72, AD 519864. In March 1974, the remaining pieces of the seven Improved Acoustic Locator Systems were transferred to the US Navy for use by the Los Angeles Police Department to evaluate their utility on police helicopters.

DESCRIPTION OF SYSTEM

The components of the Improved System are shown in Figure 1. The system weighs 41.5 lbs, occupies about 1.3 cu ft, and uses about 80 watts of electrical power at 28 VDC. In addition to the sensor pod, electronics box, and two displays shown in Figure 1, there are three interconnecting cables and various hardware used to mount these components to the two aircraft used.

A training device is also part of the equipment. This device provides simulated signals to a system while on the ground and allows operator training in interpretation of the display without the need for flying and firing.

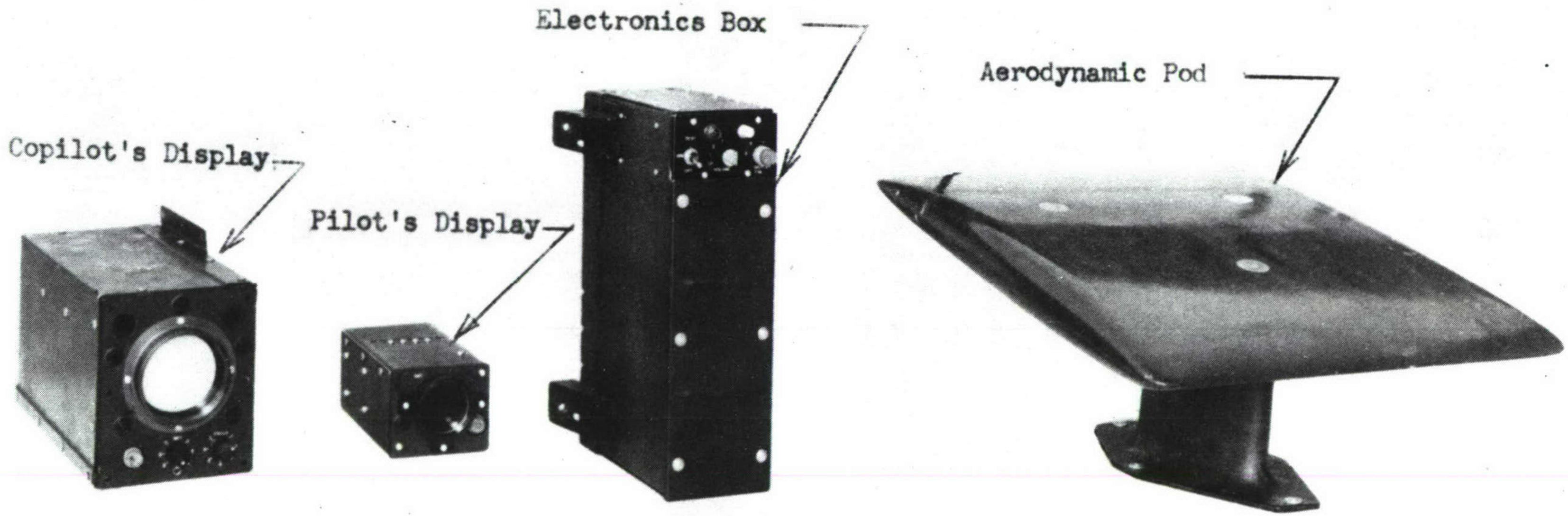

Figure 1. Improved Acoustic Locator System

PRINCIPLES OF OPERATION

The Acoustic Locator System utilizes the acoustic signature generated by the firing of small-arms to detect and locate the source of small-arms fire directed toward the aircraft. The ballistic shock wave from the passing projectile is used to alert that fire is being received and then the direction of the arriving muzzle blast wave is used to indicate the direction to the source of fire. In addition to the direct waves, it is usually possible to receive a reflection of the ballistic shock wave from the ground.

In operation the system measures the transit time of the acoustic shock waves as they traverse three microphones mounted in the pad under the aircraft. The sequence in which these three microphones are traversed by a shock wave is related to the azimuth direction of the arriving wave. The time that it takes this shock front to traverse the three microphones is an indication of the depression angle of the wave. The Acoustic Locator System utilizes this information and displays the results on a PPI-type cathode ray tube display located in the pilot's and co-pilot's compartment of the aircraft. With this information the air crew can determine the direction of arrival of the shock front.

The Acoustic Locator System is not able to distinguish reliably between these two waves; hence, the system is designed to display the occurrence of both waves (and their reflections) and the judgement of the observer is used to distinguish between the two types of waves. Only the muzzle blast wave, which expands spherically about the weapon, provides the true direction to the source of fire.

TEST PROCEDURES AND RESULTS

Appendix A is the report of the contractor, Operations Research Inc., which describes the test design and the test results with the system mounted on a UH-1 aircraft. Appendix B describes a "check" test with the system mounted on an AH-1G. During both tests the operator of the system, flying in the co-pilot's seat, observed a single round fired from various types of weapons as the aircraft flew a clover leaf pattern centered over a fixed line of fire. The operator would then interpret the display, recording the azimuth and elevation to the weapons that he considered to be the source of the fire. The results of these tests for the various types of weapons, various miss distances, and various altitudes and speeds of the aircraft were then compiled and are reported in these reports.

CONCLUSIONS

1. The Acoustic Locator System experienced a higher-than-desired false-alarm rate. The false alarms were caused either by reflection of aircraft noises from the ground (when the aircraft is at low altitude) or by rotor "pops."

2. At speeds above 120 to 150 knots the noise of wind passing over the microphones increased to a level such that signals could not be detected at useful ranges.

3. The multiplicity of signals received from a single round (ballistic shock wave, sometimes the ballistic shock wave reflected from the ground, a muzzle blast and possibly a reflected muzzle blast) was confusing and required trained, experienced operators to operate the system. A training device was supplied with the systems to overcome this problem.

4. The detection of the source of ground fire directed at aircraft remains an operational problem. The US Army Land Warfare Laboratory has investigated both acoustic techniques and infrared techniques for detecting small arms and has found that both are range limited. Another approach which was not tried but which should be considered for future developments is a small, light-weight, airborne radar for detecting the bullet trajectory in the vicinity of the aircraft and a computer to determine the source of fire.

APPENDIX A

TEST AND ANALYSIS OF THE IMPROVED ACOUSTIC LOCATOR SYSTEM ABOARD THE UH-1

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Operations Research Incorporated

TEST AND ANALYSIS OF AN ACOUSTIC

LOCATOR SYSTEM (U)

By

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PREFACE

The purpose of this work has been to obtain insights into the performance of an Acoustic Locator System prior to its employment in a tactical environment. The contents of this document consist of field test plans and the collected data from these tests. It is envisioned that this document would not be published as a separate report from the Limited War Laboratory, but would provide inputs to various reports to be subsequently published by the LWL. This effort comprises a portion (Work Assignment No. 6) of Contract No. DAAD05-68-C-0119, and consists of the design, monitoring and reporting results of the series of field tests of the equipment mentioned.

TABLE OF CONTENTS

(~~C~~) I. INTRODUCTION

(U) The Army is developing an Acoustic Locator System (ALS) that is to be used aboard an aircraft for detecting the presence of ground fire directed at the aircraft and for locating the source of the fire in terms of azimuth and depression angles relative to the aircraft.

(~~C~~) The performance of the system is dependent upon the receipt of a bullet shock wave, a reflected bullet shock wave and a weapon muzzle blast. For this reason, an investigation of various factors which might affect this performance was conducted by a series of field tests at Aberdeen Proving Ground, Maryland. These tests provided information relevant to system performance while considering such factors as; weapon to aircraft range, bullet miss distance, aircraft altitude, aircraft speed, aircraft heading relative to the weapon position and type of weapon being used.

(U) The contractor (ORI) was requested to (1) develop a test plan for evaluating the performance of the ALS, (2) monitor the implementation of the plan and, (3) reduce and analyze the resulting data from these tests.

(U) Section 2. of this document, supported by Appendix B, discusses the tests conducted. Section 3. presents the data, in reduced form, from basic tests of the system along with a discussion of the special tests which were required and of the acceptance tests of the hardware of four additional Acoustic Locator Systems.

(U) Appendix A is the computer listing of the raw data collected during the tests.

(U) Appendix C is the work assignment which initiated this contractor effort.

(~~C~~) II. DISCUSSION OF TESTS

(U) The test plan, dated 2 July 1968, is included as Appendix B to this report. The conduct of the tests was as outlined in the plan. The plan called for "blocks" of tests to be conducted—each block at a given range and bullet miss distance with altitude, speed, azimuth, and weapon type varied within each block. The blocks of tests were to be conducted in an order best satisfying a priority scheme developed by the test director in order that limitations of time and resources would impose a minimum penalty on the ALS test program.

Range Ft. / Miss Dist.	500	750	1000	1200	1400	1600
100 Ft.						
200 Ft.		2 Aug	5 Aug	7 Aug	8 Aug	
300 Ft.	7 Aug	5 Aug	8 Aug	2 Aug		

(~~C~~) FIGURE 1; TEST BLOCKS

(C) The above figure represents the program blocks of tests which were considered as feasible. Because of time limitations, only 8 blocks were run. The dates on which each of these blocks was conducted indicates the priority established for conduct of the tests. As can be seen, 100 foot miss distances and 1600 ft. ranges were assigned a lower priority and subsequently were not a part of the basic test program. The 8 highest priority blocks of tests were conducted and provide valuable data for performance evaluation of the ALS.

(C) As a further means of meeting time and range limitations, the test design allowed for the program within each test block to be changed if necessary. The 15 and 1000 ft test altitudes were eliminated during the basic tests. In addition, the planned aircraft speed of 0 knots was changed to 20 knots when it became apparent that the hover speed over the range marker was somewhat difficult to maintain.

(C) The basic test plan was a factorial test design to include six factors considered to have most effect on system performance and was the means for providing the basic statistical information on the overall system performance.

(U) Special tests were conducted for two purposes:

a. To demonstrate system performance in terms of additional levels of the six basic factors, and

b. To demonstrate system performance in terms of additional factors.

(C) A total of eight special tests were conducted as follows:

Special Test No. 1

Data from this test have been designated as test M. The purpose of the test was to investigate levels of altitude in addition to those levels used in the factorial tests. This group of tests were all conducted using a range of 500 ft., a miss distance of 300 ft., a speed of 20 knots and using the M14 weapon. One run (4 tests) were conducted at each of eight altitude steps: 25, 50, 75, 100, 150, 200, 300 and 500 feet. These 32 tests were conducted on August 8, 1968.

Special Test No. 2

The purpose of this test was to investigate the performance of the system when fire from more than one source was being directed toward the aircraft. A 50 caliber MG was located such that the range would be 500 feet and the miss distance 100 feet. The M60 was located such that the range was 500 feet and the miss distance 300 feet with the bullet path located on the opposite side of the aircraft from the 50 cal. bullet path. Two cloverleaf patterns were run, each with the aircraft at 200 ft. altitude and 80 knots speed. During the first run, each weapon fired a single round and during the second run, each weapon fired a five round burst. These 8 tests were conducted on August 8, 1968 and data from these tests are referred to as being test N in this document.

Special Test No. 3

These tests were conducted on August 13, 1968 for the purpose of investigating additional levels of range and speed, additional weapons, and the rapid fire of the weapons. There were 120 tests in this group, all except 12 were conducted at 80 knots. These 12 were conducted at 100 knots. Ranges were 1000, 1200, and 1400 feet with miss distance of 100 and 200 feet. Various weapons were fired during these tests. The weapons included the M1, M16, M14, M60 50 cal., AK56, 7.62, 12.5, 20 mm, and the 23 mm. Data from these tests are designated as test O in this document.

Special Test No. 4

On August 8, 1968, eight tests were conducted in an attempt to evaluate system performance for detecting ground fire while return fire is being generated from the aircraft. This situation was performed at 500 ft. range, 200 foot miss distance, 200 foot aircraft altitude and 40 knots speed. The M14 was fired from the ground position while return fire was from the M60 located inside the aircraft.

Special Test No. 5

Eight tests were conducted on August 9, 1968 for the purpose of investigating system performance with the aircraft loaded with additional weight.

It was expected that increased aircraft weight might cause additional rotor pops which would be picked up by the system as false alarms thereby readjusting the system threshold levels. An additional 1400# of weight were in the aircraft. Other parameter levels included; range, 500 feet; miss distance 200 feet; speed 80 knots; altitude 200 feet; and weapon M14. Data from these tests are noted as test Q in this document.

Special Test No. 6

The basic test program was conducted so that the path of a passing bullet was theoretically in the same horizontal plane as the aircraft. On August 9, 1968, 16 tests were conducted where the bullet path was higher than the aircraft indicating a specific miss direction. The levels of the parameters which remained constant for these tests were; range 500 feet, altitude 200 feet, and speed 20 knots. Aircraft headings were 90° and 270° only indicating fire from aft and in front of the aircraft. Although the weapons were positioned at the normal 100 foot miss distance position, the elevation angles of the weapons were adjusted so as to provide a miss distance of 200 feet for 8 tests and 300 feet for the other eight tests. Weapons used were the 50 caliber for eight tests and the M60 for the other eight tests. Data from these tests are referred to as test R in this document.

Special Test No. 8

For this group of tests, the system was installed in a UH-1B helicopter as opposed to the UH-1D helicopter used for the majority of the other tests. A normal block of tests was run with the exception of the 40 knot speed, the 750 ft. range, the 1000 range-200 miss distance, 2300 ft. range-200 ft. miss distance, the 1400 ft. range and the M16 weapon. On August 16, 1968, a total of 104 tests were conducted for the expressed purpose. Data from these tests are referred to in this document as test T.

(U) The above tests did not include 96 tests conducted on August 19, 1968 with the same plan but with a portion of the instrumentation being disconnected. Restuls of these 96 tests are referred to as Test U in this document.

(C) Acceptance tests were conducted for four additional ALS. System one was tested on August 22, system two and three on August 26 and system four on August 27. A total of 96 tests were conducted on each of the four systems. These tests provided an investigation of all the levels of parameters investigated during the factorial tests with the following exceptions.

(a) 750 and 1400 feet range

(b) 200 ft. miss distance at 1000 and 1200 ft. range

(c) 40 knot speed at all ranges

(d) M16 weapon at all ranges.

This, in effect, resulted in the same test plan used in special test 8.

(U) Minor modifications were provided for in the flexible test plan and the net result of the total program reflects a reasonable test plan, good implementation of the plan, and the collection of valuable data describing the performance of the ALS.

(C) III. PRESENTATION OF DATA

(U) This section is divided into three parts as inferred in Section 1. The attempt has been to present only the basic test results in a reduced form. Computer listings of the test data appear in Appendix A. These data were placed on punch cards which easily allowed for the necessary sorting and listing to be done to facilitate this effort. Additional sorts can easily be made to produce additional combinations of factors for any desired analysis at a later time.

Part 1. Factorial Tests

(C) Data from these tests include all combinations of the test parameters listed below with exception of the 500 ft range 200 ft miss distance and the 1400 ft range 300 ft miss distance.

Range	- 500, 750, 1000, 1200, 1400 ft.
Miss Distance	- 200 and 300 ft.
Aircraft Altitude	- 50, 200 and 500 ft.
Aircraft Speed	- 20, 40 and 80 knots
Aircraft Heading	- 0, 90, 180 and 270 degrees
Weapons fired	- M-16, M-14 and 50 cal MG

(C) Figure 2. shows the probability of receiving a certain number of signals at each of the ranges. The mean of the five values of the upper curve is .92 which represents the overall probability of detection for the test conditions.

(U) Figure 3. reveals how each of the test parameters affected the probability of detection. All the curves in Figure 3. are based on probability of detection being defined as the receipt of one or more of the signals.

(U)Figure 4. shows the relative frequency of azimuth errors being as specified in the bounds as noted in the graph legend.

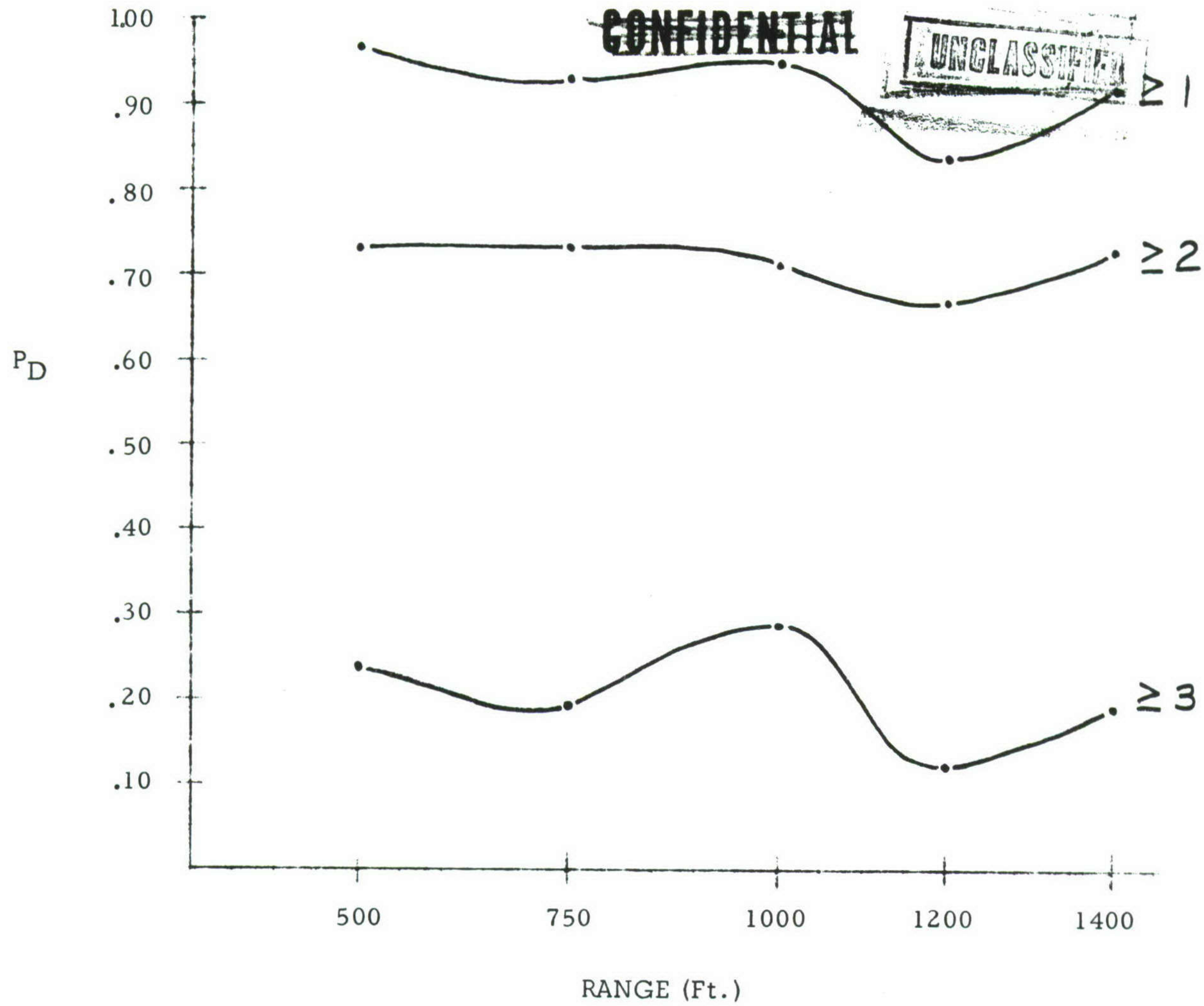
(U) Figure 5. shows the effect of each test parameter on the azimuth error at each of the various test ranges.

(C) Figure 6. reveals the effect of each of the test parameters on those cases where the azimuth error was less than 7.5°. This value was chosen as a reasonable value for resolution of reading the display. Azimuth error is defined as the absolute difference between the recorded angle and the calculated angle.

(C) Figure 7. reveals the accuracy of the reported azimuth as a function of the number of signals received on the ALS. The mean azimuth error for all test conditions was 27.7°.

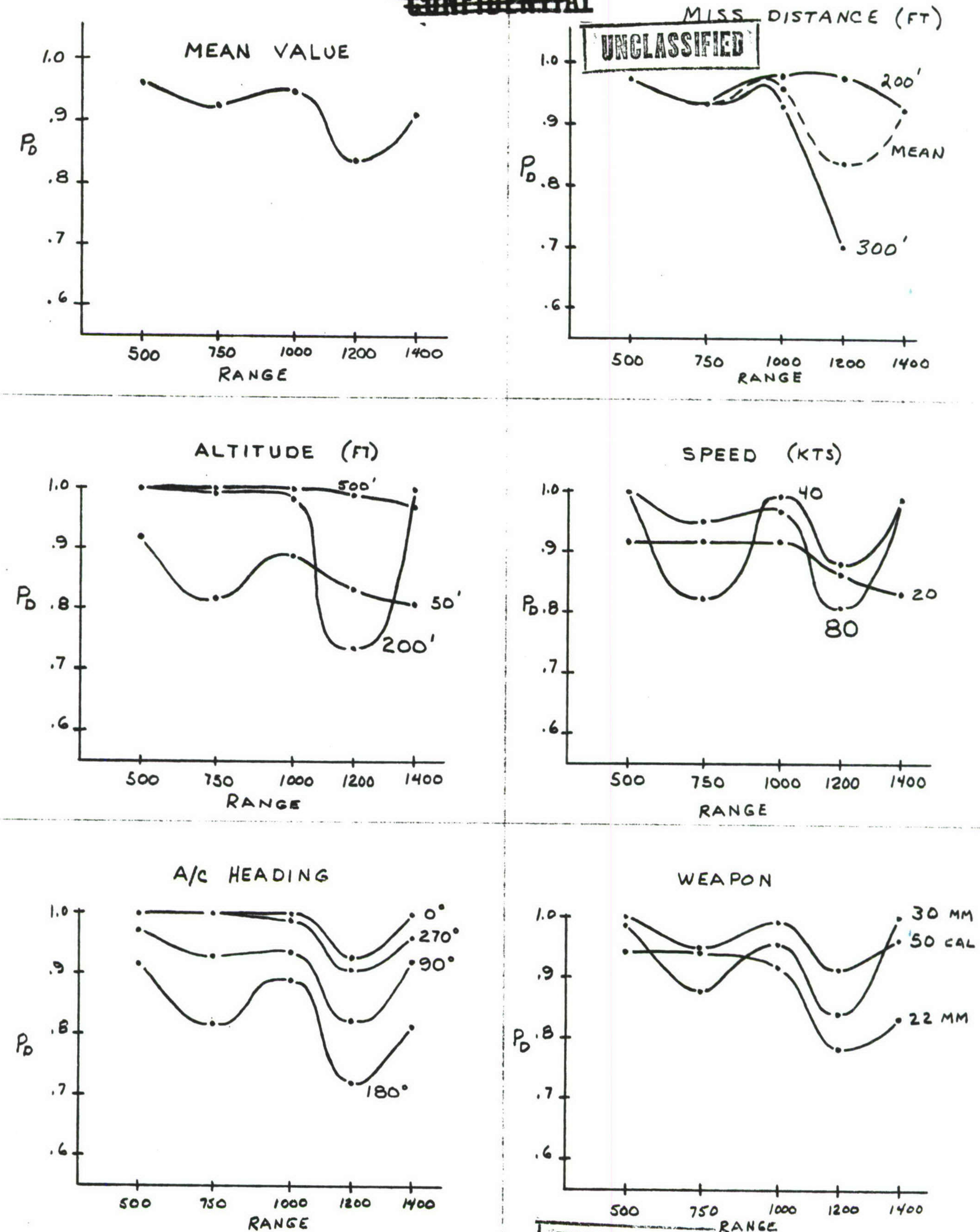
(U)Figure 8. indicates the relative frequency of the depression error being within certain bounds. Figure 9. reveals the effect of each of the test parameters on the depression angle error.

(C) Figure 10. indicates the depression angle error as a function of the calculated depression angle. This shows a decrease in reading error with an increase in the calculated depression angle. This can be accounted for since the display is such that the accuracy of reading larger depression angles is inherently better than for reading smaller angles.



Signals Received	RANGE (Ft.)					TOTAL
	500	750	1000	1200	1400	
None	3	14	10	32	8	67
3 or More	26	43	63	25	21	178
2 or More	79	159	143	137	79	507
1 or More	105	202	206	172	100	785
TOTAL	108	216	216	204	108	852

(C) FIGURE 2. PROBABILITY OF DETECTION



(~~C~~) FIGURE 3. P_D AS A FUNCTION OF TEST PARAMETERS

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		RANGE (Ft.)					TOTALS		
		500	750	1000	1200	1400	N	X	P_D
Miss Distance	200		7-108	3-108	3-108	8-108	432	21	.951
	300	3-108	7-108	7-108	29-96		420	46	.890
A/C Altitude	50	3-36	13-72	8-72	12-72	7-36	288	43	.851
	200	0-36	1-72	2-72	19-72	0-36	288	22	.924
	500	0-36	0-72	0-72	1-60	1-36	276	2	.993
A/C Speed	20	3-36	6-72	6-72	10-72	6-36	288	31	.892
	40	0-36	5-84	1-72	8-60	1-36	288	15	.948
	80	0-36	3-60	3-72	14-72	1-36	276	21	.924
A/C Heading	90	1-27	4-54	3-54	9-51	2-27	213	19	.911
	180	2-27	10-54	6-54	14-51	5-27	213	37	.826
	270	0-27	0-54	1-54	5-51	1-27	213	7	.967
	0	0-27	0-54	0-54	4-51	0-27	213	4	.981
Weapon	22	2-36	4-72	6-72	15-68	6-36	284	33	.884
	30	1-36	7-72	3-72	11-68	0-36	284	22	.923
	50	0-36	3-72	1-72	6-68	2-36	284	12	.958
TOTAL	N	108	216	216	204	108	852		
	X	3	14	10	32	8	67		
	P_D	.972	.935	.954	.843	.926	.920		

N = Number of Tests Conducted
X = Number of Tests Where No Signal Was Received
s-t indicates of t tests conducted, s tests provided no signal

(~~C~~) FIGURE 3. (Cont.) P_D AS A FUNCTION OF TEST PARAMETERS

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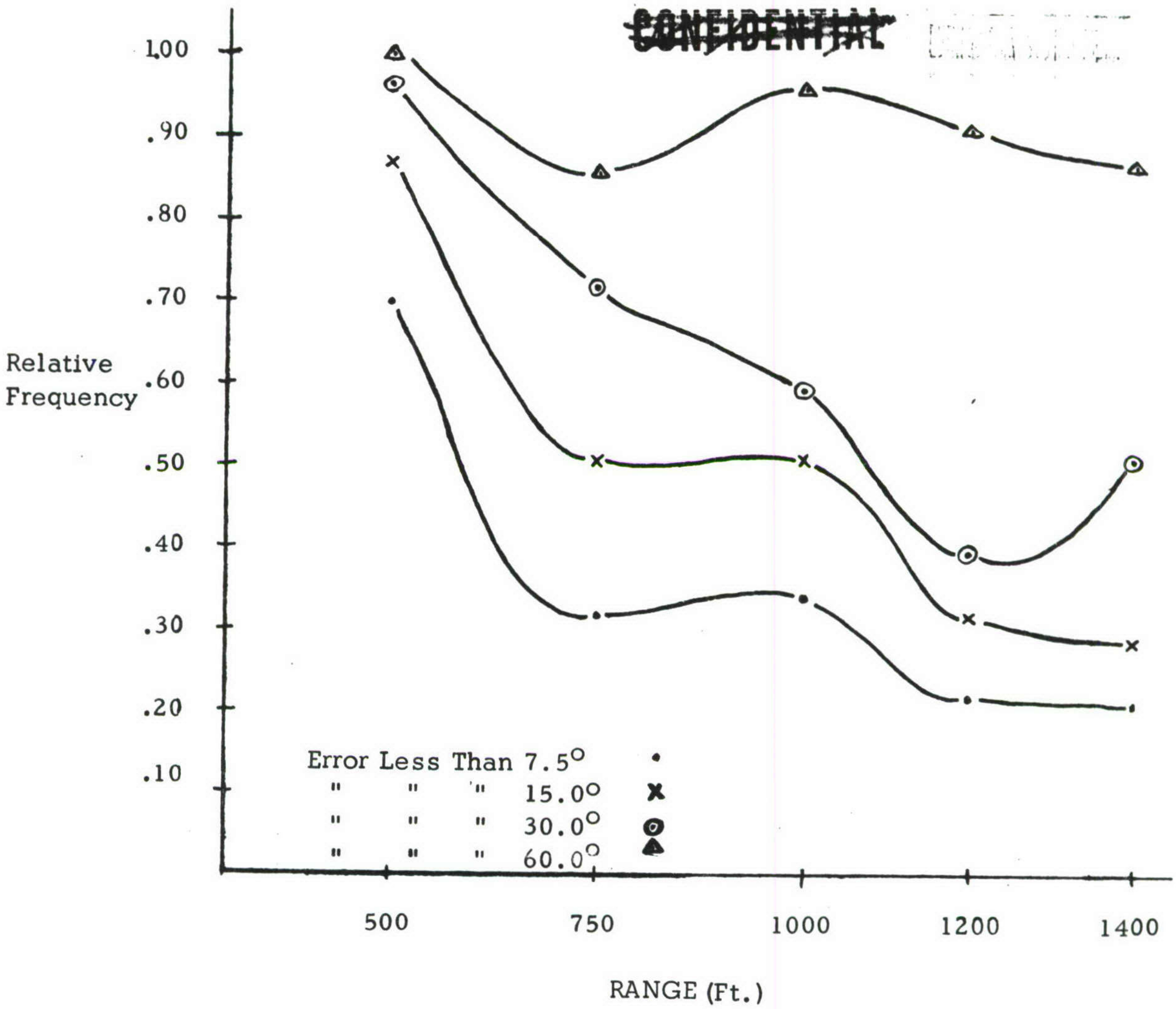
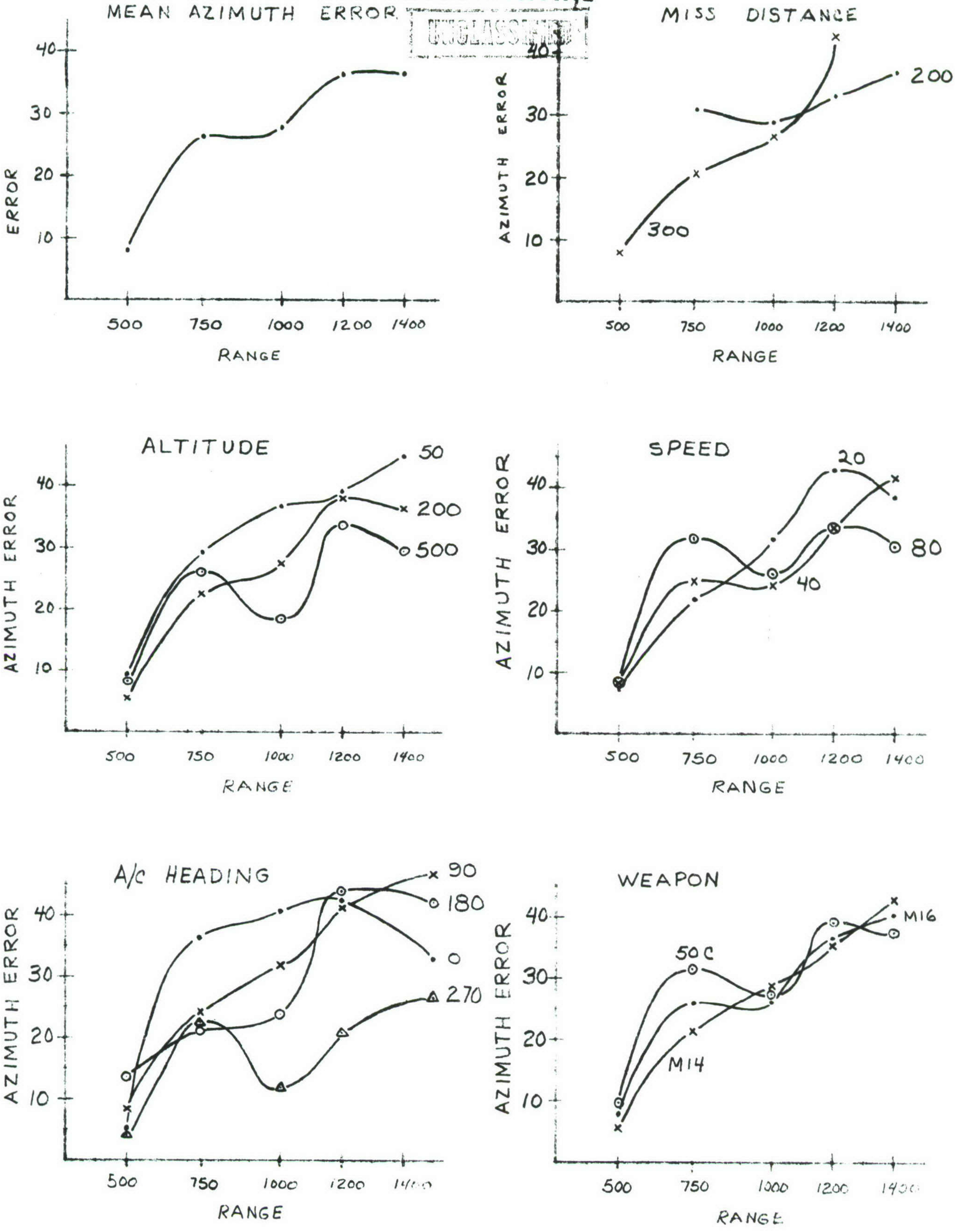


Number of detections with azimuth error	RANGE (Ft.)				
	500	750	1000	1200	1400
less than 7.5°	73	64	71	38	21
less than 15.0°	91	102	106	55	28
less than 30°	101	146	122	68	51
less than 60°	105	173	199	155	87
Total Detections	105	202	206	172	100

(~~C~~U) FIGURE 4. FREQUENCY OF AZIMUTH ERROR

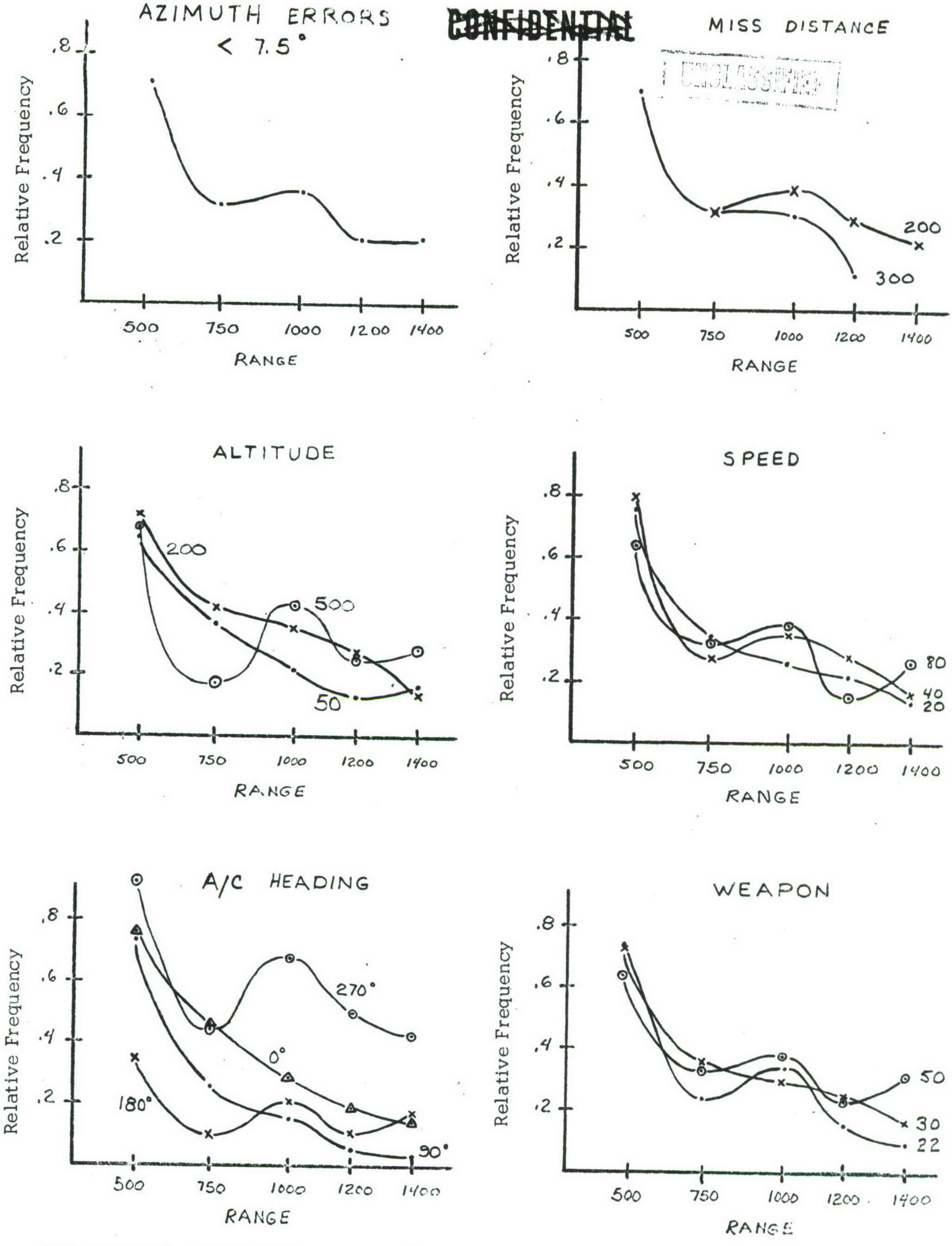


(U) FIGURE 5. AZIMUTH ERROR AS A FUNCTION OF TEST PARAMETERS

RANGE		500		750		1000		1200		1400		TOTALS	
		N	μ	N	μ	N	μ	N	μ	N	μ	N	μ
Miss Distance	200			99	30.7	105	28.2	103	33.6	100	36.7	407	32.2
	300	103	7.8	99	21.0	100	26.1	66	42.5			368	22.5
A/C Altitude	50	31	9.4	55	29.5	63	36.7	58	39.2	29	45.0	236	33.1
	200	36	5.7	71	22.8	70	27.3	52	38.2	36	36.7	265	26.6
	500	36	8.7	72	26.0	72	18.6	59	34.2	35	29.8	274	24.0
A/C Speed	20	31	7.8	63	21.8	66	31.4	62	43.1	30	38.5	252	29.8
	40	36	7.9	79	25.0	70	24.4	50	33.4	35	41.5	270	30.0
	80	36	7.8	56	31.7	69	26.0	57	33.8	35	30.4	253	27.0
A/C Heading	0	26	5.5	54	36.4	54	40.2	47	42.5	27	33.0	208	34.4
	90	25	8.2	49	24.6	50	31.8	41	41.1	25	46.3	190	30.8
	180	25	13.4	43	20.8	48	23.6	38	44.6	22	42.0	176	28.3
	270	27	4.7	53	21.8	53	11.8	44	21.0	26	26.7	203	17.4
Weapon	M16	33	7.7	66	25.4	66	25.6	53	36.2	30	40.2	248	27.2
	M14	34	5.9	64	21.4	69	28.6	56	35.8	36	42.7	259	27.4
	50C	36	9.8	69	31.4	70	26.6	61	39.0	34	27.2	270	28.5
TOTALS	N	103		198		205		169		100		775	
	μ		7.8		26		27.2		36.2		36.7		27.5

N = Number of Tests Conducted
μ = Mean Azimuth Error (Degrees)

(U) FIGURE 5. (Cont.) AZIMUTH ERROR AS A FUNCTION OF TEST PARAMETERS



(C) FIGURE 6. FREQUENCY OF <7.5° AZIMUTH ERRORS AS A FUNCTION OF TEST PARAMETERS

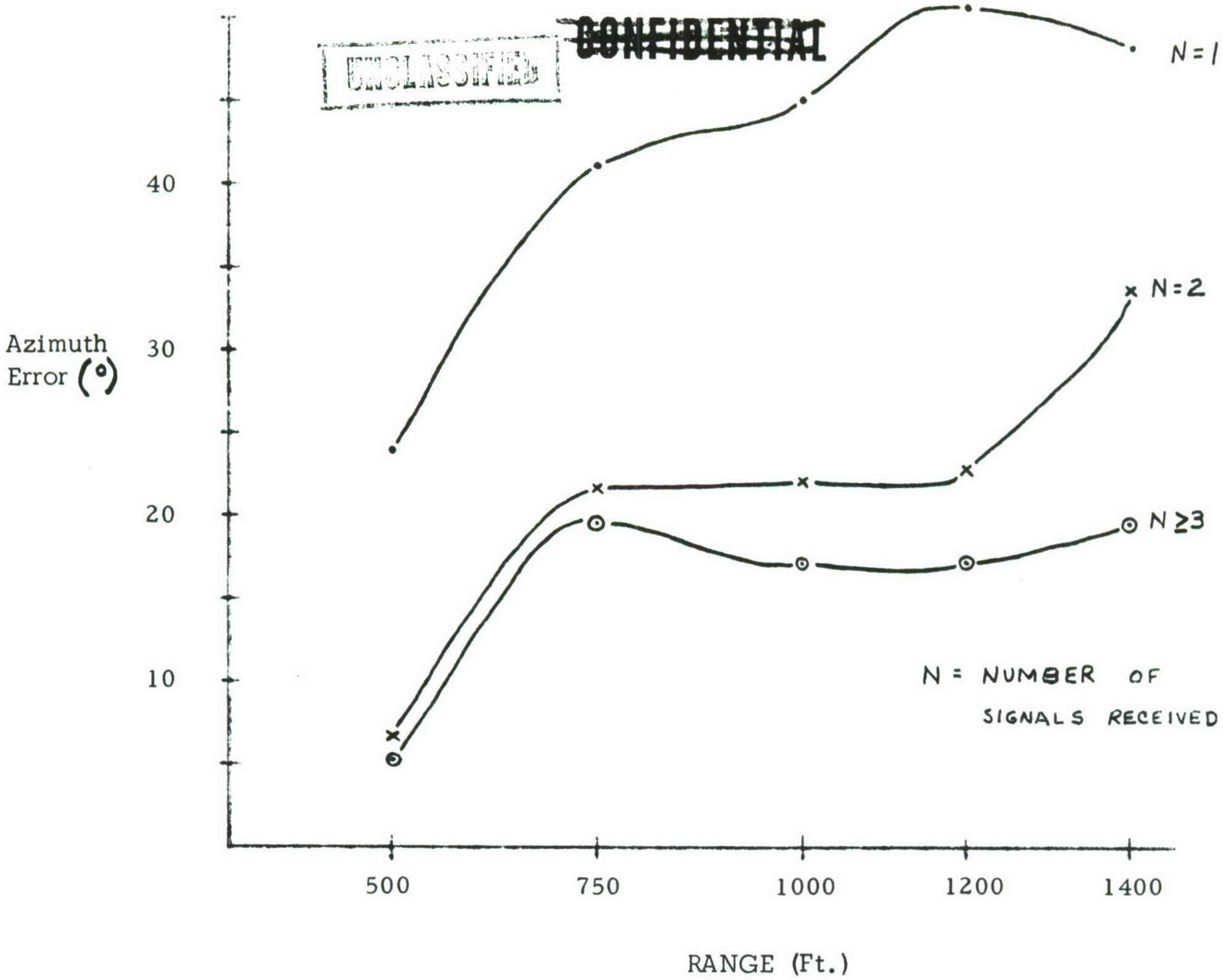
		RANGE (Ft.)					TOTALS		
		500	750	1000	1200	1400	N	X	Rel. Freq.
Miss Distance	200		32-101	40-105	31-105	21-100	411	124	.302
	300	73-105	32-101	31-101	7-67		374	143	.382
A/C Altitude	50	22-33	22-59	14-64	8-60	5-29	245	71	.290
	200	26-36	29-71	25-70	15-53	5-36	266	100	.266
	500	25-36	13-72	31-72	15-59	10-35	274	94	.343
A/C Speed	20	23-30	23-36	18-66	14-62	4-30	224	82	.366
	40	27-36	22-79	25-71	15-52	6-35	273	95	.348
	80	23-36	19-57	27-69	9-58	10-35	255	88	.345
A/C Heading	90	19-26	13-50	8-51	2-42	1-25	194	43	.222
	180	9-25	2-44	10-48	4-37	4-22	176	29	.165
	270	25-27	24-54	36-53	23-46	11-26	206	119	.578
	0	20-27	25-54	16-54	9-47	4-27	209	74	.354
Weapon	22	25-34	17-78	22-66	8-53	3-30	261	75	.288
	30	25-35	24-65	21-69	15-57	6-36	262	91	.347
	50	23-36	22-69	27-71	15-62	11-36	274	98	.358
TOTAL	N	105	202	206	172	100	785		
	X	73	64	71	38	21	267		
	Rel. Freq.	.70	.32	.34	.22	.21	.34		

N = Number of Tests Conducted

X = Number of Tests With Error $\leq 7.5^{\circ}$

s-t indicates of t tests conducted, s tests provided azimuth errors less than 7.5°

(X) FIGURE 6. (Cont.) FREQUENCY OF $<7.5^{\circ}$ AZIMUTH ERROR AS A FUNCTION OF TEST PARAMETERS



No. of Signals Received \ Range (Ft)	500		750		1000		1200		1400	
	N	μ	N	μ	N	μ	N	μ	N	μ
1	10	24	46	41.3	58	45.2	90	51.3	42	48.2
2	67	6.5	112	21.7	83	22.0	55	22.9	37	33.6
≥3	26	5.3	42	19.4	64	17.0	25	17.1	21	19.0

N = Number of Tests
μ = Mean Azimuth Error

(C) FIGURE 7. AZIMUTH ERROR BY NUMBER OF SIGNALS RECEIVED

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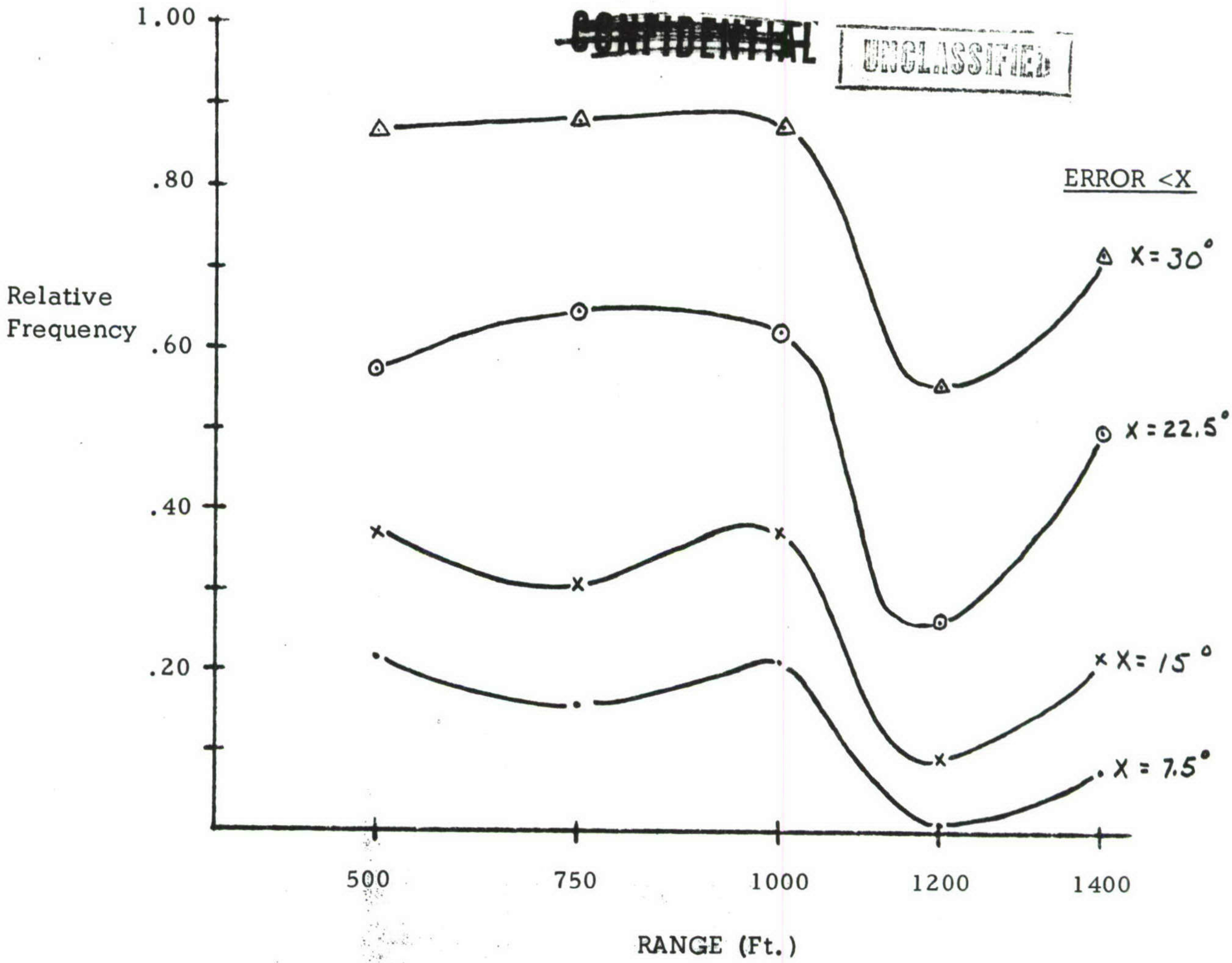

Error Less Than \ Range	500 ft.		750 ft.		1000 ft.		1200 ft.		1400 ft.	
	N	Rel. Freq.	N	Rel. Freq.	N	Rel. Freq.	N	Rel. Freq.	N	Rel. Freq.
7.5	22	.21	30	.15	42	.21	1	.07	8	.08
15.0	38	.37	60	.30	76	.37	15	.09	22	.22
22.5	59	.57	128	.64	127	.62	43	.26	50	.50
30.0	94	.90	175	.87	180	.87	93	.55	72	.72
Total Readings	104	—	200	—	206	—	168	—	100	—

(X) FIGURE 8. FREQUENCY OF DEPRESSION ANGLE ERRORS

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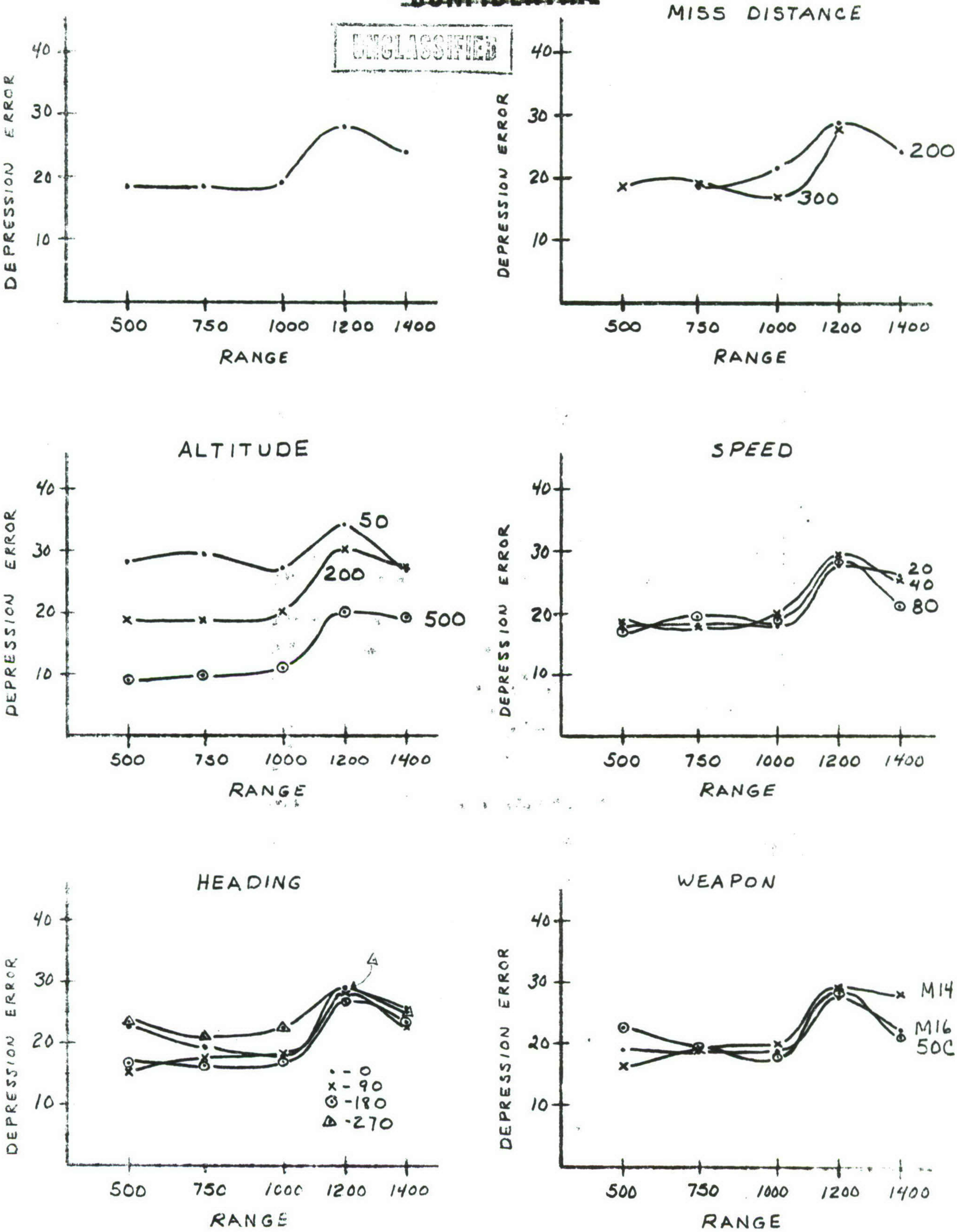
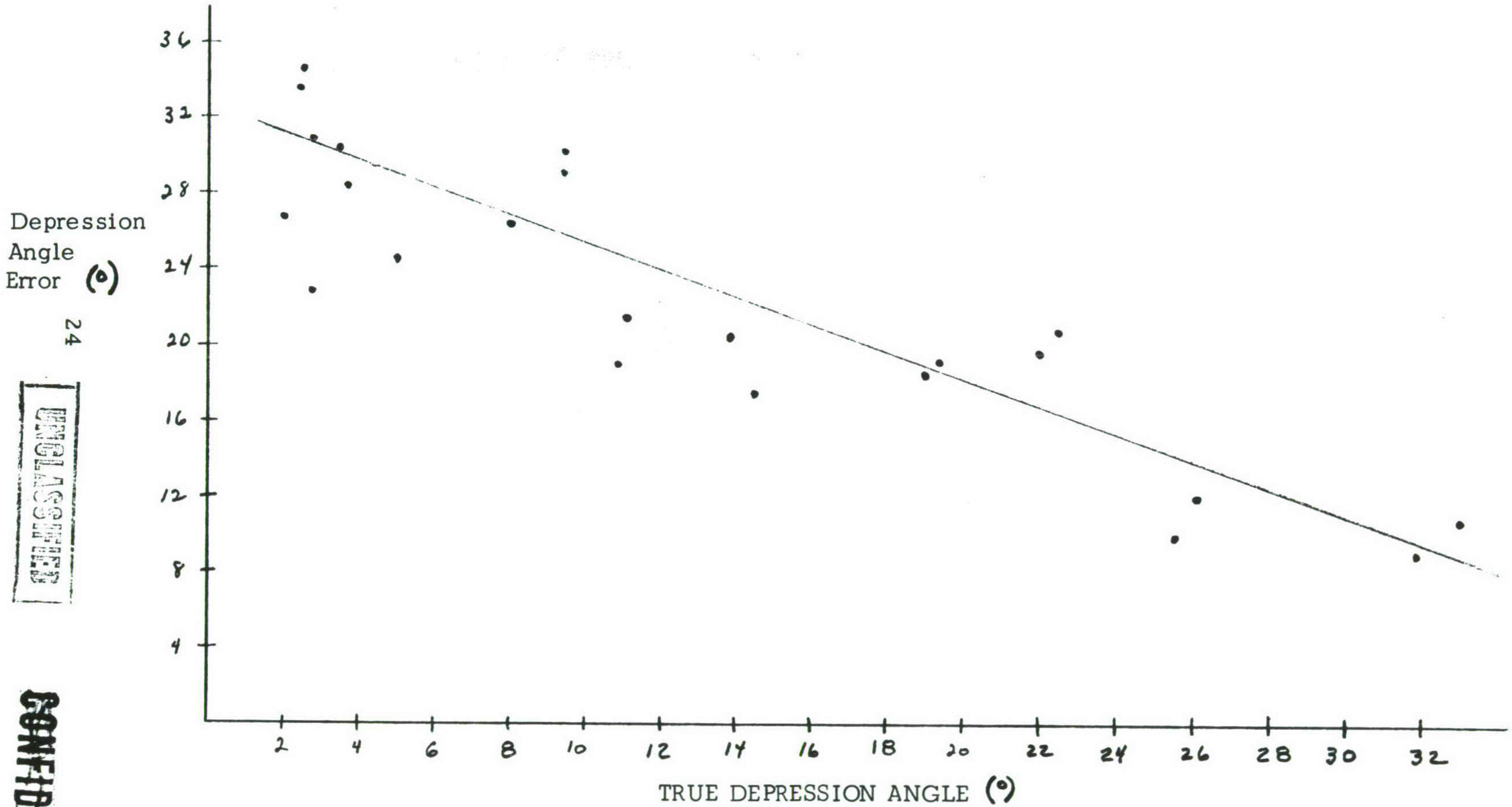


(C) FIGURE 9. DEPRESSION ANGLE ERRORS AS A FUNCTION OF TEST PARAMETERS

		500		750		1000		1200		1400		TN	μ
		N	μ	N	μ	N	μ	N	μ	N	μ		
Miss Distance	200			101	18.3	105	21.2	103	28.4	100	24.1	409	23.0
	300	104	18.0	99	18.7	101	17.0	66	27.9			370	19.7
A/C Altitude	50	36	8.9	57	29.2	64	27.0	58	34.4	29	26.6	244	26.6
	200	36	18.5	71	18.8	70	20.4	52	30.2	36	26.8	265	22.5
	500	32	27.9	72	9.9	69	19.1	59	20.4	35	19.3	270	15.9
A/C Speed	20	32	17.8	64	18.3	66	17.8	62	27.6	30	25.9	254	21.3
	40	36	18.7	79	18.0	71	20.4	49	29.5	35	25.4	270	21.8
	80	36	17.6	57	19.4	69	19.1	58	27.8	35	21.4	255	21.2
A/C Heading	0	27	22.3	54	19.1	54	17.6	46	29.2	27	25.3	208	22.2
	90	25	15.6	49	17.7	51	18.2	41	28.2	25	22.8	191	20.5
	180	25	16.4	43	16.4	48	17.4	38	26.9	22	23.3	176	19.8
	270	27	22.4	54	20.4	53	22.4	45	28.3	26	25.0	205	23.5
Weapon	22	34	18.8	67	18.3	66	18.6	54	27.5	30	22.3	251	20.9
	30	34	16.4	64	18.2	69	20.0	55	29.2	36	27.9	258	22.1
	50	36	22.4	69	18.9	71	18.4	61	28.0	34	21.6	271	21.6
TN		104		200		206		169		100		779	
μ			18.0		18.5		19.2		28.2		24.1		21.4

N = Number of Tests
u = Mean Depression Angle Error

(~~C~~) FIGURE 9. (Cont.) DEPRESSION ANGLE ERRORS AS A FUNCTION OF TEST PARAMETERS



(C) FIGURE 10. DEPRESSION ANGLE VRS ANGLE ERROR

False Alarms

([redacted]) In addition to the data presented in the graphs, charts and computer listings, an analysis of the false alarms was made in an attempt to define the conditions generating these alarms. During the total of approximately 860 tests, false alarms were indicated on the data forms for a total of 121 of these tests. The number of false alarms per test varied from 1 to 5 with a reported total of 196. Of the six basic factors investigated, it would appear as if changes in altitude and speed would most likely influence the false alarm rate. A further look at the 196 false alarms reveals they were divided in the three altitude and speed categories as noted below.

Altitude	False Alarms	Speed	False Alarms
50	98	20	35
200	52	40	111
500	47	80	50
	196		196

([redacted]) FIGURE 11. FALSE ALARM ANALYSIS

Instrumentation Effects

([redacted]) During the conduct of the tests, it became apparent that switching off and on of the power to the recording instrumentation would generate false alarms. Some tests were conducted in an attempt to define the extent of the instrumentations effect upon the performance of the ALS. The hypothesis was that the recorder feedback was causing the threshold level to be maintained at a higher point than it would normally be thus causing fewer false alarms and possibly a lower detection rate than would be experienced by the system without the recording instrumentation attached. The series

of tests disignated special tests T were chosen for a comparison since the plan of the tests with instrumentation disconnected was a repeat of the plan for the tests of group T. These tests with the instrumentation disconnected are designated as test U for this description.

	Test T	Test U	All Factorial Tests
Probability of receiving			
1 or more signals	1.00	.98	.92
2 or more signals	.69	.64	.60
3 or more signals	.19	.21	.21
4 or more signals	.03	.04	?
Number of False Alarms	5	106+*	196

* In addition some reports of false alarms merely indicated "many".

(~~S~~) FIGURE 12. INSTRUMENTATION EFFECTS ON ALS PERFORMANCE

Azimuth Error Bias

(~~S~~) The test design was such that azimuth reading errors would tend to be biased in the clockwise direction. This is primarily due to the fact that azimuth readings based on a signal other than the muzzle blast would always represent an azimuth error in the clockwise direction. A significant number of these situations were apparent in the tests. Test results are shown below:

No. of cases at the given a/c heading when / Heading	90°	180°	270°	0°
Reading was clockwise from true azimuth	169	163	129	93
Reading was identical to true azimuth	7	2	16	8
Reading was counter-clockwise from true azimuth	14	11	58	106

FIGURE 13. BIAS OF AZIMUTH ERROR AS A FUNCTION OF AIRCRAFT HEADING

No. of cases at given range when / Range (Ft.)	500	750	1000	1200	1400
Reading was clockwise from true azimuth	55	111	156	137	93
Reading was counter-clockwise from true azimuth	48	53	49	33	6

FIGURE 14. BIAS OF AZIMUTH ERRORS AS A FUNCTION OF RANGE

Part 2. Special Tests

(U)As stated in Section 1, special tests were run as demonstrations of the system under conditions other than those conducted in the basic tests. Replications during these demonstrations were limited to the extent that statistical significance of variations in values is difficult to establish. Figure 15. presents the results of each of the special tests along with a value received from the test of similar conditions during the basic test program. Raw data from the special tests appear in Appendix A and can be distinguished by the letter (M through T) appearing in column one of the computer listings.

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Special Test	Purpose of Special Test	Parameter	No. of Tests		P_D		ΔA		ΔD	
			ST	FT	ST	FT	ST	FT	ST	FT
M-1	Investigate additional levels of altitude	25'	4	0	1.0	----	35.5	----	19.8	----
		50'		288		.85	13.2	33.1	19.8	26.6
		75'		0		----	23.0	----	41.2	----
		100'		0		----	23.0	----	20.0	----
		150'		0		----	13.2	----	21.0	----
		200'		288		.92	7.8	26.6	14.8	22.5
		300'		0			11.0		10.8	
		500'	4	276	1.0	.99	7.2	24.0	10.0	15.9
N-2	Multiple firings	With one round per weapon, each signal was distinguishable. With rapid fire from each weapon, groups of signals were presented.								
O-3	Investigate the use of additional weapons	M16	8	284	.88	.884	48.5	27.1	22.3	20.9
		M14	28	284	1.00	.923	27.6	27.4	26.0	22.1
		50C	16	284	1.00	.958	83.0	28.5	17.3	21.6
		M1	8	0	1.00	----	21.2	----	13.4	----
		M60	12	0	1.00	----	68.8	----	30.8	----
		AK56	12	0	.88	----	55.6	----	23.7	----
		7.62	12	0	1.00	----	38.2	----	15.5	----
		12.5MM	12	0	1.00	----	45.6	----	24.8	----
		20MM	4	0	1.00	----	90.0	----	15.2	----
		23MM	4	0	1.00	----	132.0	----	15.2	----
	Investigate additional a/c speeds	20 Kts	0	288	----	.892	----	29.8	----	21.3
		40 Kts	0	288	----	.948	----	30.0	----	21.8
		80 Kts	108	270	.98	.924	53.5	27.0	20.5	21.2
		100 Kts	12	0	1.00	----	27.8	----	29.1	----

(X) FIGURE 15. SPECIAL TEST RESULTS

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Special Test	Purpose of Special Test	Parameter	No. of Tests ST	No. of Tests FT	P_D ST	P_D FT	Δ A ST	Δ A FT	Δ D ST	Δ D FT
P-4	Investigate Performance with firing from a/c weapons		Sparse data -- no analysis available.							
Q-5	Use of system with a aircraft loaded with an additional 1400 lbs.	500 RANGE	8	108	1.00	.972	9.1	7.8	8.8	18.0
		300 Miss Distance	8	420	↑	.890	9.1	22.5	8.8	19.7
		200 Altitude	8	288		.924	9.1	26.6	8.8	22.5
		80 Speed	8	276		.924	9.1	27.0	8.8	21.2
		90	2	213		.911	9.5	30.8	7.5	20.5
		180 Heading	2	213		.826	10.5	28.3	5.0	19.8
		270	2	213		.967	4.5	17.4	15.0	23.5
		0	2	213	↓	.981	12.0	34.4	7.5	22.2
		M14 weapon	8	284	1.00	.923	9.1	27.4	8.8	22.1
R-6	Firing <u>over</u> the a/c	1000 Range 6/	16	216	.69	.954	7.7	27.2	15.7	19.2
		100 Miss Distance	16	0	.69	----	7.7	----	15.7	----
		200 Altitude	16	288	.69	.924	7.7	26.6	15.7	22.5
		20 Speed	16	288	.69	.892	7.7	29.8	15.7	21.3
		90 Heading	8	213	.38	.911	11.5	30.8	18.7	20.5
		270	8	213	1.00	.967	5.8	17.4	14.0	23.5
		50C	8	284	.88	.958	11.5	28.5	18.7	21.6
		M60	8	0	.50	----	5.8	----	14.0	----
T-8	Use of UH-1B Helicopter	500	68	108	.97	.972	12.9	7.8	15.0	18.0
		1000 RANGE	68	216	1.00	.954	27.9	27.2	18.8	19.2
		1200	64	216	.98	.843	49.2	36.2	18.8	28.2
		300 Miss Distance	200	420	.98	.890	29.8	22.5	17.5	19.7
		50 Altitude	96	288	.97	.851	34.0	33.1	20.5	26.6
		200	104	288	1.00	.924	26.0	26.6	14.9	22.5
		20 Speed	96	288	.97	.892	28.7	29.8	18.7	21.3
		80	104	276	1.00	.924	30.7	27.0	16.5	21.2

(U) FIGURE 15. (Cont) SPECIAL TEST RESULTS

Special Test	Purpose of Special Test	Parameter		No. of Tests		P_D		Δ A		Δ D	
				ST	FT	ST	FT	ST	FT	ST	FT
T-8 (Cont)		90	Heading	50	213	.98	.911	31.9	30.8	17.5	20.5
		180	Heading	50	213	.98	.826	28.4	28.3	18.0	19.8
		270	Heading	50	213	.98	.967	22.3	17.4	20.5	23.5
		0	Heading	50	213	1.00	.981	36.3	34.4	14.0	22.2
		M14	Weapon	96	284	.97	.923	30.2	27.4	18.1	22.1
		50C	Weapon	96	284	1.00	.958	29.3	28.5	17.5	21.6
		AK56	Weapon	4	---	1.00	----	42.5	----	9.8	----
		AK47	Weapon	4	---	1.00	----	18.2	----	11.2	----
	Instrumentation Partially Disconnected	500	Range	32	108	.94	.972	7.0	7.8	15.1	18.0
		1000	Range	32	216	1.00	.954	19.7	27.2	18.9	19.2
		1200	Range	32	216	1.00	.843	41.8	36.2	20.0	28.2
		300	Miss Distance	96	420	.98	.890	23.2	22.5	18.0	19.7
		50	Altitude	48	288	.96	.851	26.8	33.1	20.9	26.6
		200	Altitude	48	288	1.00	.924	19.8	26.6	15.3	22.5
		20	Speed	48	288	.96	.892	24.8	29.8	18.6	21.3
		80	Speed	48	276	1.00	.924	21.6	27.0	17.5	21.2
		90	Heading	24	213	.96	.911	38.2	30.8	18.0	0.5
		180	Heading	24	213	1.00	.826	19.4	28.3	19.9	19.8
		270	Heading	24	213	.96	.967	19.3	17.4	19.7	23.5
		0	Heading	24	213	1.00	.981	16.3	34.4	14.6	22.2
		M14	Weapon	48	284	.96	.923	25.1	27.4	18.6	22.1
		50C	Weapon	48	284	1.00	.958	21.4	28.5	17.5	21.6

(U) FIGURE 15. (Cont) SPECIAL TEST RESULTS

NOTE:
1. ST indicates Special Test
2. FT indicates Factorial Test
3. P_D indicates probability of detection - at least one signal received
4. ΔA indicates the difference between the absolute mean of the azimuth readings for a given test and the calculated azimuth
5. ΔD indicates the difference between the absolute mean of the depression readings for a given test and the calculated depression
6. See explanation on page 7.

(~~C~~) FIGURE 15. (Cont) SPECIAL TEST RESULTS

Part 3. Acceptance Tests

(U) In addition to the hardware of the ALS tested during the basic tests, it was necessary to obtain some indication as to the performance of the hardware to be used in four additional ALS. The hardware referred to consist of four basic elements for each system. These elements are the sensor housing, an aerodynamic pod, which is externally mounted on the aircraft and contains the transducers, an electronic processing unit mounted inside the aircraft and two display units, one located for the pilot observation, the second for co-pilot observation.

(U) Data forms from the tests indicate each of the different elements used was assigned a particular number and the total system under test was comprised of the numbered elements as designated in Figure 16.

System being tested	Sensor housing number	Electronic processing unit number	Pilot display unit	Co-pilot display unit
1	7	7	6	6
2	5	6	1	2
3	3	4	7	4
4	4	5	5	5

(U) FIGURE 16. ELEMENTS OF EACH SYSTEM

(U) The raw data from these tests appear in Appendix A with a recap as shown in Figure 17. The mean values obtained from similar runs during the factorial testing appear in Figure 17 for comparison.

RANGE	PD				AZIMUTH ERROR				DEPRESSION ERROR				NUMBER OF TESTS			
	500	1000	1200	Total	500	1000	1200	Total	500	1000	1200	Total	500	1000	1200	Total
Factoral Test Mean Values	.97	.95	.84	.92	7.8	27.2	36.2	27.5	18.0	19.2	28.2	21.4	108	216	216	864
System #1	.94	.94	.97	.95	11.6	30.0	32.5	25.8	16.5	20.8	22.8	20.0	32	32	32	96
System #2	1.00	.91	.95	.95	25.3	32.8	47.7	33.2	19.5	22.8	24.6	22.0	32	32	20	84
System #3*	.88	.78	.81	.82	16.5	33.4	46.8	31.8	21.3	24.4	30.8	25.5	32	32	32	96
System #4	.94	.94	.88	.92	12.8	31.6	40.9	28.4	16.3	25.8	24.9	22.2	32	32	32	96

NOTE: P_D is based on the receipt of at least one signal

Azimuth and depression error values are degrees.

(C) FIGURE 17. ACCEPTANCE TESTS RESULTS

(C) APPENDIX A

LISTING OF TEST DATA

APPENDIX A

The data appearing in this appendix result from the computer listing of the raw data collected from the tests after it has been key punched onto data processing cards. The data required the use of 62 columns of the general purpose 80 column card with the following information provided in each column:

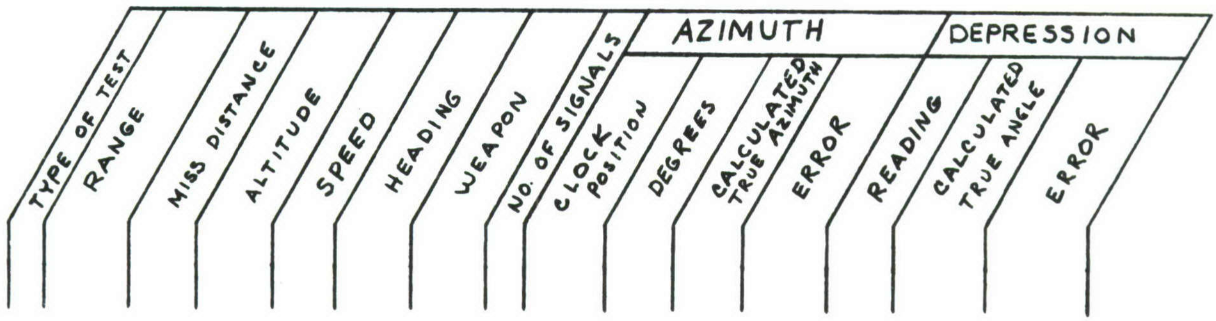
Column	Information
1	The Figure 1 indicates data from the factorial designed tests and A, B, C, D indicates data from acceptance tests 1, 2, 3 and 4 respectively. Letters M through T indicate data from Special Tests 1 through 8 respectively.
2	Blank.
3,4,5,6	Range. (Ft.)
7	Blank.
8,9,10	Miss Distance. (Ft.)
11	Blank.
12,13,14,15	Aircraft Altitude. (Ft.)
16	Blank.
17,18	Aircraft Speed. (Knots)
19	Blank.
20,21,22	Aircraft heading of 0, 90, 180, 270 indicate the firing position was located to the left of, aft of, to the right of, and in front of the aircraft at time of test.
23,24	Blank.
25,26,27	Type of weapon fired.

Column	Information
28	Blank.
29	Number of signals reported as appearing on the scope.
30	Blank.
31, 32, 33, 34	The reported clock reading regarding azimuth location of gun position.
35	Blank.
36, 37, 38	The reported clock position converted to degrees. (1200 being 0° degrees or 360°.)
39	Blank.
40, 41, 42	The calculated azimuth in degrees for the indicated test condition.
43	Blank.
44, 45, 46, 47	The variation in degrees from the reported azimuth and the calculated azimuth. Negative values indicate reading was in clockwise direction from calculated reading except on acceptance test data. Negative values of acceptance test data indicate error in counterclockwise direction.
48, 49	Blank.
50, 51	Depression angle reading. (Degrees)
52	Blank.
53, 54, 55, 56	Calculated depression angle. (Degrees)
57	Blank.
58, 59, 60, 61, 62	Variation in degrees from reading and calculated angle. Negative values indicate excessive reading angle.

```
1 1200 300 200  20   0  M14 1  300 090 284 -166  15  9.2   5.8
```

FIGURE A-1: EXAMPLE OF CARD HEADING

(U)As an aid in reading the computer listing of raw data, figure A-2 is provided which reveals a column heading for each of the columns in the listing. This temperature type figure could be cut out and placed over the columns on each page to facilitate reading initially.



(U) FIGURE A-2. COLUMN HEADINGS

(U) FACTORIAL TEST DATA

1	500	300	50	20	90	M16	0			211			4.9	.
1	500	300	50	20	180	M16	0			121			4.9	
1	500	300	50	20	270	M16	2	115	037	031	-6	30	4.9	25.1
1	500	300	50	20	0	M16	2			301		30	4.9	25.1
1	500	300	50	20	90	M14	1						4.9	.
1	500	300	50	20	180	M14	0						4.9	
1	500	300	50	20	270	M14	2	115	037	031	-6	30	4.9	25.1
1	500	300	50	20	0	M14	2	1000	300	301	1	30	4.9	25.1
1	500	300	50	20	90	50C	2	645	202	211	8	45	4.9	40.1
1	500	300	50	20	180	50C	3	400	120	121	1	45	4.9	40.1
1	500	300	50	20	270	50C	2	115	037	031	-6	30	4.9	25.1
1	500	300	50	20	0	50C	2	1000	300	301	1	30	4.9	25.1
1	500	300	50	40	90	M16	1	815	247	211	-36	45	4.9	40.1
1	500	300	50	40	180	M16	2	430	135	121	-14	30	4.9	25.1
1	500	300	50	40	270	M16	2	100	030	031	1	30	4.9	25.1
1	500	300	50	40	0	M16	2	1000	300	301	1	30	4.9	25.1
1	500	300	50	40	90	M14	3	720	220	211	-9	30	4.9	25.1
1	500	300	50	40	180	M14	2	430	135	121	-14	30	4.9	25.1
1	500	300	50	40	270	M14	2	100	030	031	1	35	4.9	30.1
1	500	300	50	40	0	M14	3	1000	300	301	1	30	4.9	25.1
1	500	300	50	40	90	50C	2	715	217	211	-6	35	4.9	30.1
1	500	300	50	40	180	50C	2	415	127	121	-6	35	4.9	30.1
1	500	300	50	40	270	50C	2	115	037	031	-6	30	4.9	25.1
1	500	300	50	40	0	50C	1	1130	345	301	-44	40	4.9	35.1
1	500	300	50	80	90	M16	1	815	247	211	-36	40	4.9	35.1
1	500	300	50	80	180	M16	3	415	127	121	-6	30	4.9	25.1
1	500	300	50	80	270	M16	1	100	030	031	1	40	4.9	35.1
1	500	300	50	80	0	M16	3	1000	300	301	1	30	4.9	25.1
1	500	300	50	80	90	M14	2	700	210	211	1	30	4.9	25.1
1	500	300	50	80	180	M14	3	415	127	121	-6	30	4.9	25.1
1	500	300	50	80	270	M14	2	115	037	031	-6	30	4.9	25.1
1	500	300	50	80	0	M14	2	1000	300	301	1	30	4.9	25.1
1	500	300	50	80	90	50C	1	800	240	211	-29	30	4.9	25.1
1	500	300	50	80	180	50C	2	400	120	121	1	30	4.9	25.1
1	500	300	50	80	270	50C	1	210	065	031	-34	30	4.9	25.1
1	500	300	50	80	0	50C	2	1000	300	301	1	30	4.9	25.1

1	500	300	200	20	90	M16	2	715	217	211	-6	30	19.0	11.0
1	500	300	200	20	180	M16	2	430	135	121	-14	40	19.0	21.0
1	500	300	200	20	270	M16	3	100	030	031	1	45	19.0	26.
1	500	300	200	20	0	M16	2	1015	307	301	-6	30	19.0	11.
1	500	300	200	20	90	M14	2	715	217	211	-6	30	19.0	11.
1	500	300	200	20	180	M14	2	430	135	121	-14	30	19.0	11.
1	500	300	200	20	270	M14	2	100	030	031	1	40	19.0	21.
1	500	300	200	20	0	M14	2	1000	300	301	1	35	19.0	16.
1	500	300	200	20	90	50C	3	715	217	211	-6	45	19.0	26.
1	500	300	200	20	180	50C	2	430	130	121	-9	40	19.0	21.
1	500	300	200	20	270	50C	2	115	037	031	-6	35	19.0	16.
1	500	300	200	20	0	50C	1	1100	330	301	-29	45	19.0	26.
1	500	300	200	40	90	M16	2	700	210	211	1	45	19.0	26.
1	500	300	200	40	180	M16	2	415	127	121	-6	40	19.0	21.
1	500	300	200	40	270	M16	3	100	030	031	1	40	19.0	21.
1	500	300	200	40	0	M16	2	1000	300	301	1	35	19.0	16.
1	500	300	200	40	90	M14	3	715	217	211	-6	35	19.0	16.
1	500	300	200	40	180	M14	3	400	120	121	1	40	19.0	21.
1	500	300	200	40	270	M14	2	115	037	031	-6	40	19.0	21.0
1	500	300	200	40	0	M14	2	1000	300	301	1	35	19.0	16.
1	500	300	200	40	90	50C	2	715	217	211	-6	30	19.0	11.
1	500	300	200	40	180	50C	2	415	127	121	-6	35	19.0	16.
1	500	300	200	40	270	50C	2	120	040	031	-9	40	19.0	21.

1	500	300	200	40	0	50C	1	1100	330	301	1	45	19.0	26.
1	500	300	200	80	90	M16	3	700	210	211	1	30	19.0	11.
1	500	300	200	80	180	M16	2	415	127	121	-6	30	19.0	11.
1	500	300	200	80	270	M16	3	100	030	031	1	45	19.0	26.
1	500	300	200	80	0	M16	2	1000	300	301	1	40	19.0	21.
1	500	300	200	80	90	M14	2	700	210	211	1	30	19.0	11.
1	500	300	200	80	180	M14	2	430	135	121	-14	30	19.0	11.0
1	500	300	200	80	270	M14	2	110	035	031	-4	45	19.0	26.
1	500	300	200	80	0	M14	2	945	292	301	8	40	19.0	21.0
1	500	300	200	80	90	50C	2	645	202	211	8	20	19.0	1.0
1	500	300	200	80	180	50C	2	420	130	121	-9	30	19.0	11.0
1	500	300	200	80	270	50C	2	100	030	031	1	45	19.0	26.0
1	500	300	200	80	0	50C	2	945	292	301	8	60	19.0	41.0

1	500	300	500	20	90	M16	2	715	217	211	-6	45	40.6	4.4
1	500	300	500	20	180	M16	2	445	144	121	-23	70	40.6	29.4
1	500	300	500	20	270	M16	1	100	030	031	1	70	40.6	29.4
1	500	300	500	20	0	M16	3	1000	300	301	1	45	40.6	4.4
1	500	300	500	20	90	M14	2	715	217	211	-6	45	40.6	4.4
1	500	300	500	20	180	M14	2	445	142	121	-21	45	40.6	4.4
1	500	300	500	20	276	M14	2	115	037	031	-6	50	40.6	9.4
1	500	300	500	20	0	M14	2	950	295	301	6	45	40.6	4.4
1	500	300	500	20	90	50C	2	715	217	211	-6	45	40.6	4.4
1	500	300	500	20	180	50C	4	500	150	121	-29	45	40.6	4.4
1	500	300	500	20	270	50C	4	115	037	031	-6	60	40.6	19.4
1	500	300	500	20	0	50C	3	1000	300	301	1	45	40.6	4.4
1	500	300	500	40	90	M16	2	700	210	211	1	40	40.6	-0.6
1	500	300	500	40	180	M16	2	500	150	121	-29	45	40.6	4.4
1	500	300	500	40	270	M16	2	115	037	031	-6	60	40.6	19.4
1	500	300	500	40	0	M16	2	935	287	301	3	50	40.6	9.4
1	500	300	500	40	90	M14	2	715	217	211	-6	30	40.6	-10.6
1	500	300	500	40	180	M14	2	445	142	121	-21	45	40.6	4.4
1	500	300	500	40	270	M14	3	100	030	031	1	60	40.6	19.4
1	500	300	500	40	0	M14	3	1000	300	301	1	45	40.6	4.4
1	500	300	500	40	90	50C	3	715	217	211	-6	40	40.6	-0.6
1	500	300	500	40	180	50C	3	445	142	121	-21	50	40.6	9.4
1	500	300	500	40	270	50C	3	115	037	031	-6	55	40.6	14.4
1	500	300	500	40	0	50C	3	1000	300	301	1	45	40.6	4.4
1	500	300	500	80	90	M16	2	715	217	211	-6	30	40.6	-10.6
1	500	300	500	80	180	M16	3	445	142	121	-21	45	40.6	4.4
1	500	300	500	80	270	M16	3	100	030	031	1	50	40.6	9.4
1	500	300	500	80	0	M16	2	945	292	301	8	45	40.6	4.4
1	500	300	500	80	90	M14	2	700	210	211	1	35	40.6	-5.6
1	500	300	500	80	180	M14	2	430	135	121	-14	45	40.6	4.4
1	500	300	500	80	270	M14	2	100	030	031	1	60	40.6	19.4
1	500	300	500	80	0	M14	2	945	292	301	8	50	40.6	9.4
1	500	300	500	80	90	50C	2	700	210	211	1	45	40.6	4.4
1	500	300	500	80	180	50C	1	500	150	121	-29	45	40.6	4.4
1	500	300	500	80	270	50C	3	100	030	031	1	60	40.6	19.4
1	500	300	500	80	0	50C	2	930	285	301	6	45	40.6	4.4

1	750	200	50	20	90	M16	1	815	247	195	-52	35	3.7	31.3
1	750	200	50	20	180	M16	0			105			3.	
1	750	200	50	20	270	M16	2	1230	015	015	0	30	3.7	26.3
1	750	200	50	20	0	M16	1	1100	330	285	-45	30	3.7	26.3
1	750	200	50	20	90	M14	0			195			3.7	.
1	750	200	50	20	180	M14	0			105			3.7	.
1	750	200	50	20	270	M14	3	1230	015	015	0	30	3.7	26.3
1	750	200	50	20	0	M14	1	1100	330	285	-45	30	3.7	26.3
1	750	200	50	20	90	50C	1	830	255	195	-60	40	3.7	36.3
1	750	200	50	20	180	50C	0			105			3.7	.
1	750	200	50	20	270	50C	1	400	120	015	-105	30	3.7	26.3
1	750	200	50	20	0	50C	1	1100	330	285	-45	30	3.7	26.3
1	750	200	50	40	90	M16	1	830	255	195	-60	35	3.7	31.3
1	750	200	50	40	180	M16	1	400	120	105	-15	30	3.7	26.3
1	750	200	50	40	270	M16	2	1230	015	015	0	30	3.7	26.3
1	750	200	50	40	0	M16	4	930	285	285	0	25	3.7	21.3
1	750	200	50	40	90	M14	2	800	240	195	-45	40	3.7	36.3
1	750	200	50	40	180	M14	0			105			3.7	.
1	750	200	50	40	270	M14	3	1230	015	015	0	30	3.7	26.3
1	750	200	50	40	0	M14	2	930	285	285	0	30	3.7	26.3
1	750	200	50	40	90	50C	2	830	255	195	-60	35	3.7	31.3
1	750	200	50	40	180	50C	2	400	120	105	-15	30	3.7	26.3
1	750	200	50	40	270	50C	2	1230	015	015	0	30	3.7	26.3
1	750	200	50	40	0	50C	1	1100	330	285	-45	50	3.7	46.3
1	750	200	50	80	90	M16	3	645	202	195	-7	30	3.7	26.3
1	750	200	50	80	180	M16	0			105			3.7	.
1	750	200	50	80	270	M16	3	1230	015	015	0	30	3.7	26.3
1	750	200	50	80	0	M16	3	900	270	285	15	30	3.7	26.3
1	750	200	50	80	90	M14	1	815	247	195	-52	35	3.7	31.3
1	750	200	50	80	180	M14	2	400	120	105	-15	30	3.7	26.3
1	750	200	50	80	270	M14	3	1230	015	015	0	30	3.7	26.3
1	750	200	50	80	0	M14	3	530	165	285	120	30	3.7	26.3
1	750	200	50	80	90	50C	1	815	247	195	-52	35	3.7	31.3
1	750	200	50	80	180	50C	2	400	120	105	-15	30	3.7	26.3
1	750	200	50	80	270	50C	2	1230	015	015	0	30	3.7	26.3
1	750	200	50	80	0	50C	2	915	277	285	7	30	3.7	26.3

1	750	200	200	20	90	M16	1	645	202	195	-7	30	14.5	15.5
1	750	200	200	20	180	M16	1	400	120	105	-15	35	14.5	20.5
1	750	200	200	20	270	M16	1	430	135	015	-120	30	14.5	15.5
1	750	200	200	20	0	M16	1	920	280	285	5	30	14.5	15.5
1	750	200	200	20	90	M14	1	800	240	195	-45	30	14.5	15.5
1	750	200	200	20	180	M14	3	300	090	105	15	35	14.5	20.5
1	750	200	200	20	270	M14	3	1215	007	015	-7	30	14.5	15.5
1	750	200	200	20	0	M14	3	930	285	285	0	30	14.5	15.5
1	750	200	200	20	90	50C	2	700	210	195	-15	30	14.5	15.5
1	750	200	200	20	180	50C	1	530	165	105	-60	35	14.5	20.5
1	750	200	200	20	270	50C	2	1230	015	015	0	30	14.5	15.5
1	750	200	200	20	0	50C	3	930	285	285	0	30	14.5	15.5
1	750	200	200	40	90	M16	1	830	255	195	-60	35	14.5	20.5
1	750	200	200	40	180	M16	2	400	120	105	-15	30	14.5	15.5
1	750	200	200	40	270	M16	1	215	075	015	-60	30	14.5	15.5
1	750	200	200	40	0	M16	2	930	285	285	0	30	14.5	15.5
1	750	200	200	40	90	M14	2	700	210	195	-15	30	14.5	15.5
1	750	200	200	40	180	M14	0			105			14.5	.
1	750	200	200	40	270	M14	2	1230	015	015	0	30	14.5	15.5
1	750	200	200	40	0	M14	2	630	195	285	90	60	14.5	45.5
1	750	200	200	40	90	50C	2	700	210	195	-15	30	14.5	15.5
1	750	200	200	40	180	50C	2	400	120	105	-15	30	14.5	15.5
1	750	200	200	40	270	50C	2	1235	015	015	0	30	14.5	15.5

1	750	200	200	40	0	50C	2	930	285	285	0	30	14.5	15.5
1	750	200	200	80	90	M16	1	830	255	195	-60	40	14.5	25.5
1	750	200	200	80	180	M16	2	400	120	105	-15	30	14.5	15.5
1	750	200	200	80	270	M16	1	1230	015	015	0	40	14.5	25.5
1	750	200	200	80	0	M16	4	900	270	285	15	30	14.5	15.5
1	750	200	200	80	270	M16	3	430	135	015	-120	30	14.5	15.5
1	750	200	200	80	90	M14	4	630	195	195	0	30	14.5	15.5
1	750	200	200	80	180	M14	2	400	120	105	-15	30	14.5	15.5
1	750	200	200	80	0	M14	2	915	277	285	7	30	14.5	15.5
1	750	200	200	80	90	50C	2	630	195	195	0	30	14.5	15.5
1	750	200	200	80	180	50C	2	400	120	105	-15	30	14.5	15.5
1	750	200	200	80	270	50C	2	430	135	015	-120	30	14.5	15.5
1	750	200	200	80	0	50C	2	915	277	285	7	30	14.5	15.5
1	750	200	500	20	90	M16	2	700	210	195	-15	40	33.0	7.
1	750	200	500	20	180	M16	2	400	120	105	-15	35	33.0	2.
1	750	200	500	20	270	M16	2	1200	000	015	15	60	33.0	27.
1	750	200	500	20	0	M16	2	920	280	285	5	35	33.0	2.
1	750	200	500	20	90	M14	2	700	210	195	-15	40	33.0	7.
1	750	200	500	20	180	M14	2	400	120	105	-15	45	33.0	12.
1	750	200	500	20	270	M14	2	1230	015	015	0	45	33.0	12.
1	750	200	500	20	0	M14	1	630	195	285	90	60	33.0	27.
1	750	200	500	20	90	50C	1	700	210	195	-15	60	33.0	27.
1	750	200	500	20	180	50C	2	400	120	105	-15	45	33.0	12.
1	750	200	500	20	270	50C	1	230	075	015	-60	65	33.0	32.
1	750	200	500	20	0	50C	1	900	270	285	15	45	33.0	12.
1	750	200	500	40	90	M16	1	830	255	195	-60	45	33.0	12.
1	750	200	500	40	180	M16	2	430	135	105	-30	40	33.0	7.
1	750	200	500	40	270	M16	1	230	075	015	-60	35	33.0	2.
1	750	200	500	40	0	M16	2	900	270	285	15	40	33.0	7.
1	750	200	500	40	90	M14	2	630	195	195	0	30	33.0	-3.
1	750	200	500	40	180	M14	3	415	127	105	-22	35	33.0	2.
1	750	200	500	40	270	M14	2	100	030	015	-15	35	33.0	2.
1	750	200	500	40	0	M14	2	530	165	285	120	35	33.0	2.
1	750	200	500	40	90	50C	2	700	210	195	-15	35	33.0	2.
1	750	200	500	40	180	50C	2	430	135	105	-30	35	33.0	2.
1	750	200	500	40	270	50C	2	550	175	015	-160	50	33.0	17.
1	750	200	500	40	0	50C	2	900	270	285	15	45	33.0	12.
1	750	200	500	80	90	M16	2	640	200	195	-5	30	33.0	-3.
1	750	200	500	80	180	M16	3	400	120	105	-15	45	33.0	12.
1	750	200	500	80	270	M16	2	1250	025	015	-10	50	33.0	17.
1	750	200	500	80	0	M16	3	500	150	285	135	45	33.0	12.
1	750	200	500	80	90	M14	2	640	200	195	-5	30	33.0	-3.
1	750	200	500	80	180	M14	2	415	127	105	-22	40	33.0	7.
1	750	200	500	80	270	M14	2	1250	025	015	-10	50	33.0	17.
1	750	200	500	80	0	M14	2	900	270	285	15	55	33.0	22.
1	750	200	500	80	90	50C	2	650	205	195	-10	30	33.0	-3.
1	750	200	500	80	180	50C	1	515	157	105	-52	45	33.0	12.
1	750	200	500	80	270	50C	2	1250	025	015	-10	50	33.0	17.
1	750	200	500	80	0	50C	2	500	150	285	135	45	33.0	12.
1	750	300	50	20	90	M16	1			202			3.5	.
1	750	300	50	20	180	M16	1			112			3.5	.
1	750	300	50	20	270	M16	3	1215	007	022	14	30	3.5	26.5
1	750	300	50	20	0	M16	1	1100	330	292	-38	30	3.5	26.5
1	750	300	50	20	90	M14	2	815	247	202	-45	35	3.5	31.5
1	750	300	50	20	180	M14	0						3.5	.
1	750	300	50	20	270	M14	2	1200	000	022	22	50	3.5	46.5

1	750	300	50	20	0	M14	2	930	285	292	7	20	3.5	16.5
1	750	300	50	20	90	50C							3.5	.
1	750	300	50	20	180	50C	1	515	157	112	-45	30	3.5	26.5
1	750	300	50	20	270	50C	1	1245	022	022	0	30	3.5	26.5
1	750	300	50	20	0	50C	1	930	285	292	7	30	3.5	26.5
1	750	300	50	40	90	M16	1	830	255	202	-53	30	3.5	26.5
1	750	300	50	40	180	M16	0						3.5	.
1	750	300	50	40	270	M16	1	1250	025	022	-3	30	3.5	26.5
1	750	300	50	40	0	M16	2	700	210	292	82	45	3.5	41.5
1	750	300	50	40	90	M14	0						3.5	.
1	750	300	50	40	180	M14	2	400	120	112	-8	30	3.5	26.5
1	750	300	50	40	270	M14	2	100	030	022	-8	30	3.5	26.5
1	750	300	50	40	0	M14	1	930	285	292	7	30	3.5	26.5
1	750	300	50	40	90	50C	1	830	255	202	-53	35	3.5	31.5
1	750	300	50	40	180	50C	0						3.5	.
1	750	300	50	40	270	50C	1	100	030	022	-8	35	3.5	31.5
1	750	300	50	40	0	50C	2	930	285	292	7	30	3.5	26.5
1	750	300	50	80	90	M16	0						3.5	
1	750	300	50	80	180	M16	1	400	120	112	-8	30	3.5	26.5
1	750	300	50	80	270	M16	2	1250	025	022	-3	40	3.5	36.5
1	750	300	50	80	0	M16	2	1220	010	292	-78	30	3.5	26.5
1	750	300	50	80	90	M14	2	800	240	202	-38	40	3.5	36.5
1	750	300	50	80	180	M14	0						3.5	
1	750	300	50	80	270	M14	3	1230	015	022	7	35	3.5	31.5
1	750	300	50	80	0	M14	3	930	285	292	7	30	3.5	26.5
1	750	300	50	80	90	50C	2	600	180	202	22	60	3.5	56.5
1	750	300	50	80	180	50C	2	100	030	112	92	35	3.5	31.5
1	750	300	50	80	270	50C	2	950	295	022	87	30	3.5	26.5
1	750	300	50	80	0	50C	2	930	285	292	7	30	3.5	26.5

1	750	300	200	20	90	M16	1	830	255	202	-53	45	13.9	31.1
1	750	300	200	20	180	M16	2	400	120	112	-8	45	13.9	31.1
1	750	300	200	20	270	M16	2	100	030	022	-8	45	13.9	31.1
1	750	300	200	20	0	M16	2	945	292	292	0	30	13.9	16.1
1	750	300	200	20	90	M14	1	830	255	202	-53	40	13.9	26.1
1	750	300	200	20	180	M14	2	345	112	112	0	30	13.9	16.1
1	750	300	200	20	270	M14	3	1245	022	022	0	30	13.9	16.1
1	750	300	200	20	0	M14	2	930	285	292	7	30	13.9	16.1
1	750	300	200	20	90	50C	2	645	202	202	0	30	13.9	16.1
1	750	300	200	20	180	50C	2	400	120	112	-8	45	13.9	31.1
1	750	300	200	20	270	50C	2	1245	022	022	0	35	13.9	21.1
1	750	300	200	20	0	50C	2	930	285	292	7	30	13.9	16.1
1	750	300	200	40	90	M16	2	645	202	202	0	30	13.9	16.1
1	750	300	200	40	180	M16	2	500	150	112	38	40	13.9	26.1
1	750	300	200	40	270	M16	2	100	030	022	8	40	13.9	26.1
1	750	300	200	40	0	M16	2	945	292	292	0	30	13.9	16.1
1	750	300	200	40	90	M14	2	645	202	202	0	30	13.9	16.1
1	750	300	200	40	180	M14	1	515	157	112	45	30	13.9	16.1
1	750	300	200	40	270	M14	2	100	030	022	-8	35	13.9	21.1
1	750	300	200	40	0	M14	2	530	165	292	127	30	13.9	16.1
1	750	300	200	40	90	50C	2	645	202	202	0	30	13.9	16.1
1	750	300	200	40	180	50C	2	500	150	112	-38	30	13.9	16.1
1	750	300	200	40	270	50C	2	100	030	022	-8	40	13.9	16.1
1	750	300	200	40	0	50C	2	530	165	292	127	30	13.9	16.1

1	750	300	200	40	90	M16	3	700	210	202	-8	30	13.9	16.1
1	750	300	200	40	180	M16	3	400	120	112	-8	35	13.9	21.1
1	750	300	200	40	270	M16	3	100	030	022	-8	35	13.9	21.1
1	750	300	200	40	0	M16	2	940	290	292	2	30	13.9	16.1
1	750	300	200	40	90	M14	4	700	210	202	-8	35	13.9	21.1

1	750	300	200	40	180	M14	2	400	120	112	-8	35	13.9	21.1
1	750	300	200	40	270	M14	3	100	030	022	-8	35	13.9	21.1
1	750	300	200	40	0	M14	3	950	295	292	-3	30	13.9	16.1
1	750	300	200	40	90	50C	2	635	197	202	4	30	13.9	16.1
1	750	300	200	40	180	50C	2	400	120	112	-8	40	13.9	26.1
1	750	300	200	40	270	50C	2	100	030	022	-8	35	13.9	21.1
1	750	300	200	40	0	50C	2	350	115	292	177	30	13.9	16.1
1	750	300	500	20	90	M16	2	700	210	202	-8	30	31.8	-1.8
1	750	300	500	20	180	M16	2	430	135	112	-23	40	31.8	8.2
1	750	300	500	20	270	M16	3	100	030	022	-8	40	31.8	8.2
1	750	300	500	20	0	M16	2	930	285	292	7	35	31.8	3.2
1	750	300	500	20	90	M14	2	700	210	202	-8	35	31.8	3.2
1	750	300	500	20	180	M14	2	400	120	112	-8	40	31.8	8.2
1	750	300	500	20	270	M14	3	1230	015	022	7	40	31.8	8.2
1	750	300	500	20	0	M14	4	900	270	292	22	40	31.8	8.2
1	750	300	500	20	90	50C	3	700	210	202	-8	35	31.8	3.2
1	750	300	500	20	180	50C	2	400	120	112	-8	40	31.8	8.2
1	750	300	500	20	270	50C	4	1230	015	022	7	40	31.8	8.2
1	750	300	500	20	0	50C	3	900	270	292	22	35	31.8	3.2
1	750	300	500	40	90	M16	2	700	210	202	-8	30	31.8	-1.8
1	750	300	500	40	180	M16	2	430	135	112	-23	35	31.8	3.2
1	750	300	500	40	270	M16	3	1200	000	022	22	10	31.8	-21.8
1	750	300	500	40	0	M16	2	920	280	292	12	40	31.8	8.2
1	750	300	500	40	90	M14	3	700	210	202	-8	30	31.8	-1.8
1	750	300	500	40	180	M14	2	400	120	112	-8	40	31.8	8.2
1	750	300	500	40	270	M14	2	1240	020	022	-8	45	31.8	13.2
1	750	300	500	40	0	M14	3	920	280	292	12	45	31.8	13.2
1	750	300	500	40	90	50C	3	700	210	202	-8	35	31.8	3.2
1	750	300	500	40	180	50C	2	430	135	112	-23	45	31.8	13.2
1	750	300	500	40	270	50C	3	1250	025	022	-3	45	31.8	13.2
1	750	300	500	40	0	50C	2	930	285	292	7	40	31.8	8.2
1	750	300	500	80	90	M16	1	800	240	202	-38	40	31.8	8.2
1	750	300	500	80	180	M16	2	400	120	112	-8	40	31.8	8.2
1	750	300	500	80	270	M16	2	1220	010	022	12	35	31.8	3.2
1	750	300	500	80	0	M16	1	1030	315	292	-23	70	31.8	38.2
1	750	300	500	80	90	M14	1	800	240	202	-38	40	31.8	8.2
1	750	300	500	80	180	M14	3	345	112	112	0	25	31.8	-6.8
1	750	300	500	80	270	M14	3	1240	020	022	2	40	31.8	8.2
1	750	300	500	80	0	M14	1	1100	330	292	-38	60	31.8	28.2
1	750	300	500	80	90	50C	2	650	205	202	-3	30	31.8	-1.8
1	750	300	500	80	180	50C	1	500	150	112	-38	45	31.8	13.2
1	750	300	500	80	270	50C	2	100	030	022	-8	45	31.8	13.2
1	750	300	500	80	0	50C	3	500	150	292	142	30	31.8	-1.8

1	1000	200	50	20	90	M16	0			191			2.8	•
1	1000	200	50	20	180	M16	0			101			2.8	•
1	1000	200	50	20	270	M16	3	1215	007	011	3	30	2.8	27.2
1	1000	200	50	20	0	M16	2	1030	315	281	-45	0	2.8	-2.8
1	1000	200	50	20	90	M14	1	800	240	191	-49	35	2.8	32.2
1	1000	200	50	20	180	M14	2	330	105	101	-4	35	2.8	32.2
1	1000	200	50	20	270	M14	3	1200	000	011	11	30	2.8	27.2
1	1000	200	50	20	0	M14	2	1050	325	281	-45	35	2.8	32.2
1	1000	200	50	20	90	50C	1	800	240	191	-49	35	2.8	32.2
1	1000	200	50	20	180	50C	2	500	150	101	-49	30	2.8	27.2
1	1000	200	50	20	270	50C	1	200	060	011	-49	30	2.8	27.2
1	1000	200	50	20	0	50C	2	100	030	281	-109	45	2.8	42.2
1	1000	200	50	40	90	M16	2	730	225	191	-34	40	2.8	37.2
1	1000	200	50	40	180	M16	1	500	150	101	-49	30	2.8	27.2
1	1000	200	50	40	270	M16	3	1215	007	011	3	30	2.8	27.2
1	1000	200	50	40	0	M16	3	1045	322	281	-41	35	2.8	32.2
1	1000	200	50	40	90	M14	2	745	232	191	-41	35	2.8	32.2
1	1000	200	50	40	180	M14	2	320	100	101	1	30	2.8	27.2
1	1000	200	50	40	270	M14	3	1215	007	011	3	30	2.8	27.2
1	1000	200	50	40	0	M14	1	1100	330	281	-49	30	2.8	27.2
1	1000	200	50	40	90	50C	1	800	240	191	-49	30	2.8	27.2
1	1000	200	50	40	180	50C	1	520	160	101	-59	30	2.8	27.2
1	1000	200	50	40	270	50C	2	1215	007	011	3	60	2.8	57.2
1	1000	200	50	40	0	50C	2	1100	330	281	-49	40	2.8	37.2
1	1000	200	50	80	90	M16	2	700	210	191	-19	40	2.8	37.2
1	1000	200	50	80	180	M16	2	420	130	101	-29	15	2.8	12.2
1	1000	200	50	80	270	M16	2	1220	010	011	1	60	2.8	57.2
1	1000	200	50	80	0	M16	2	1045	322	281	-41	45	2.8	42.2
1	1000	200	50	80	90	M14	1	800	240	191	-49	30	2.8	27.2
1	1000	200	50	80	180	M14	3	330	105	101	-4	30	2.8	27.2
1	1000	200	50	80	270	M14	3	1215	007	011	3	35	2.8	32.2
1	1000	200	50	80	0	M14	1	1050	325	281	-44	30	2.8	27.2
1	1000	200	50	80	90	50C	2	750	235	191	-44	30	2.8	27.2
1	1000	200	50	80	180	50C	2	330	105	101	-4	30	2.8	27.2
1	1000	200	50	80	270	50C	2	1215	007	011	3	35	2.8	32.2
1	1000	200	50	80	0	50C	2	300	090	281	-169	30	2.8	27.2
1	1000	200	200	20	90	M16	1	800	240	191	-49	30	11.1	18.9
1	1000	200	200	20	180	M16	1	500	150	101	-49	30	11.1	18.9
1	1000	200	200	20	270	M16	4	1230	015	011	-4	30	11.1	18.9
1	1000	200	200	20	0	M16	3	1000	300	281	-19	45	11.1	33.9
1	1000	200	200	20	90	M14	1	815	247	191	-56	35	11.1	23.9
1	1000	200	200	20	180	M14	1	500	150	101	-49	30	11.1	18.9
1	1000	200	200	20	270	M14	3	1230	015	011	-4	35	11.1	23.9
1	1000	200	200	20	0	M14	3	915	277	281	3	30	11.1	18.9
1	1000	200	200	20	90	50C	2	645	202	191	-11	35	11.1	23.9
1	1000	200	200	20	180	50C	4	345	112	101	-11	35	11.1	23.9
1	1000	200	200	20	270	50C	3	1230	015	011	-4	35	11.1	23.9
1	1000	200	200	20	0	50C	5	915	285	281	-4	25	11.1	13.9
1	1000	200	200	40	90	M16	2	720	220	191	-29	40	11.1	28.9
1	1000	200	200	40	180	M16	3	350	115	101	-14	40	11.1	28.9
1	1000	200	200	40	270	M16	2	1245	022	011	-11	35	11.1	23.9
1	1000	200	200	40	0	M16	4	320	100	281	-179	30	11.1	18.9
1	1000	200	200	40	90	M14	1	815	247	191	-56	35	11.1	23.9
1	1000	200	200	40	180	M14	3	350	115	101	-14	35	11.1	23.9
1	1000	200	200	40	270	M14	3	1245	022	011	-11	35	11.1	23.9
1	1000	200	200	40	0	M14	3	930	285	281	-4	30	11.1	18.9
1	1000	200	200	40	90	50C	2	645	202	191	-11	30	11.1	18.9
1	1000	200	200	40	180	50C	4	330	105	101	-4	40	11.1	28.9
1	1000	200	200	40	270	50C	2	1240	020	011	-9	35	11.1	23.9

1	1000	200	200	40	0	50C	2	920	280	281	1	20	11.1	8.9
1	1000	200	200	80	90	M16	1	800	240	191	-49	30	11.1	18.9
1	1000	200	200	80	180	M16	0						11.1	.
1	1000	200	200	80	270	M16	2	1230	015	011	-4	40	11.1	28.9
1	1000	200	200	80	0	M16	1	1100	330	281	-49	45	11.1	33.9
1	1000	200	200	80	90	M14	1	800	240	191	-49	30	11.1	18.9
1	1000	200	200	80	180	M14	1	430	135	101	-34	10	11.1	-1.1
1	1000	200	200	80	270	M14	2	1230	015	011	-4	30	11.1	18.9
1	1000	200	200	80	0	M14	2	100	030	281	-109	45	11.1	33.9
1	1000	200	200	80	90	50C	1	800	240	191	-49	40	11.1	28.9
1	1000	200	200	80	180	50C	2	330	105	101	-4	30	11.1	18.9
1	1000	200	200	80	270	50C	2	1215	007	011	3	10	11.1	-1.1
1	1000	200	200	80	0	50C	2	900	270	281	11	30	11.1	18.9

1	1000	200	500	20	90	M16	1	800	240	191	-49	40	26.1	13.9
1	1000	200	500	20	180	M16	2	345	112	101	-11	45	26.1	18.9
1	1000	200	500	20	270	M16	1	200	060	011	-49	30	26.1	3.9
1	1000	200	500	20	0	M16	2	910	275	281	6	30	26.1	3.9
1	1000	200	500	20	90	M14	2	640	200	191	-9	30	26.1	3.9
1	1000	200	500	20	180	M14	2	330	105	101	-4	40	26.1	13.9
1	1000	200	500	20	270	M14	1	200	060	011	-49	30	26.1	3.9
1	1000	200	500	20	0	M14	4	300	090	281	-169	60	26.1	33.9
1	1000	200	500	20	90	50C	2	630	195	191	-4	35	26.1	8.9
1	1000	200	500	20	180	50C	4	400	120	101	-19	40	26.1	13.9
1	1000	200	500	20	270	50C	4	1230	015	011	-4	45	26.1	18.9
1	1000	200	500	20	0	50C	2	900	270	281	11	30	26.1	3.9
1	1000	200	500	40	90	M16	2	630	195	191	-4	30	26.1	3.9
1	1000	200	500	40	180	M16	2	400	120	101	-19	40	26.1	13.9
1	1000	200	500	40	270	M16	2	1215	007	011	3	45	26.1	18.9
1	1000	200	500	40	0	M16	1	1100	330	281	-49	50	26.1	23.9
1	1000	200	500	40	90	M14	3	650	205	191	-14	45	26.1	18.9
1	1000	200	500	40	180	M14	2	400	120	101	-19	45	26.1	18.9
1	1000	200	500	40	270	M14	2	1210	005	011	6	50	26.1	23.9
1	1000	200	500	40	0	M14	3	920	280	281	1	45	26.1	18.9
1	1000	200	500	40	90	50C	4	630	195	191	-4	30	26.1	3.9
1	1000	200	500	40	180	50C	5	400	120	101	-19	40	26.1	13.9
1	1000	200	500	40	270	50C	3	1230	015	011	-4	45	26.1	18.9
1	1000	200	500	40	0	50C	3	920	280	281	1	30	26.1	3.9
1	1000	200	500	80	90	M16	2	630	195	191	-4	30	26.1	3.9
1	1000	200	500	80	180	M16	1	400	120	101	-19	35	26.1	8.9
1	1000	200	500	80	270	M16	3	1220	010	011	1	30	26.1	3.9
1	1000	200	500	80	0	M16	2	900	270	281	11	30	26.1	3.9
1	1000	200	500	80	90	M14	2	630	195	191	-4	30	26.1	3.9
1	1000	200	500	80	180	M14	2	350	115	101	-14	30	26.1	3.9
1	1000	200	500	80	270	M14	2	1230	015	011	-4	45	26.1	18.9
1	1000	200	500	80	0	M14	2	900	270	281	11	40	26.1	13.9
1	1000	200	500	80	90	50C	3	625	192	191	-1	30	26.1	3.9
1	1000	200	500	80	180	50C	2	400	120	101	-19	40	26.1	13.9
1	1000	200	500	80	270	50C	2	1220	010	011	1	50	26.1	23.9
1	1000	200	500	80	0	50C	2	300	090	281	-169	30	26.1	3.9

1	1000	300	50	20	90	M16	1	800	240	197	-43	30	2.7	27.3
1	1000	300	50	20	180	M16	1	330	105	107	2	45	2.7	42.3
1	1000	300	50	20	270	M16	0			017			2.7	.
1	1000	300	50	20	0	M16	1	1100	330	287	-43	0	2.7	-2.7
1	1000	300	50	20	90	M14	1	800	240	197	-43	30	2.7	27.3
1	1000	300	50	20	180	M14	0			107			2.7	.
1	1000	300	50	20	270	M14	1	200	060	017	-43	15	2.7	12.3
1	1000	300	50	20	0	M14	1	1100	330	287	-43	10	2.7	7.3

1	1000	300	50	20	90	50	1	800	240	197	-43	30	2.7	27.3
1	1000	300	50	20	180	50	0						2.7	.
1	1000	300	50	20	270	50	1	200	060	017	-43	0	2.7	-2.7
1	1000	300	50	20	0	50	1	1100	330	287	-43	15	2.7	12.3
1	1000	300	50	40	90	M16	0						2.7	.
1	1000	300	50	40	180	M16	1	500	150	107	-43	25	2.7	22.3
1	1000	300	50	40	270	M16	2	100	030	017	-13	30	2.7	27.3
1	1000	300	50	40	0	M16	2	1100	330	287	-43	15	2.7	12.3
1	1000	300	50	40	90	M14	1	800	240	197	-43	30	2.7	27.3
1	1000	300	50	40	180	M14	1	500	150	107	-43	20	2.7	17.3
1	1000	300	50	40	270	M14	3	100	030	017	-13	30	2.7	27.3
1	1000	300	50	40	0	M14	3	600	180	287	107	40	2.7	37.3
1	1000	300	50	40	90	50	1					30	2.7	27.3
1	1000	300	50	40	180	50	1	500	150	107	-43	20	2.7	17.3
1	1000	300	50	40	270	50	2	1230	015	017	2	30	2.7	27.3
1	1000	300	50	40	0	50	1	1100	330	287	-43	30	2.7	27.3
1	1000	300	50	80	90	M16	0						2.7	.
1	1000	300	50	80	180	M16	1	500	150	107	-43	15	2.7	12.3
1	1000	300	50	80	270	M16	3	1230	015	017	2	30	2.7	27.3
1	1000	300	50	80	0	M16	1	1100	330	287	-43	30	2.7	27.3
1	1000	300	50	80	90	M14	1	800	240	197	-43	25	2.7	22.3
1	1000	300	50	80	180	M14	0						2.7	.
1	1000	300	50	80	270	M14	2	100	030	017	-13	45	2.7	42.3
1	1000	300	50	80	0	M14	1	1100	330	287	-43	30	2.7	27.3
1	1000	300	50	80	90	50	1	800	240	197	-43	25	2.7	22.3
1	1000	300	50	80	180	50	2	400	120	107	-13	30	2.7	27.3
1	1000	300	50	80	270	50	1	200	060	017	-43	20	2.7	17.3
1	1000	300	50	80	0	50	1	1100	330	287	-43	30	2.7	27.3

1	1000	300	200	20	90	M16	1	800	240	197	-43	30	10.9	19.1
1	1000	300	200	20	180	M16	1	500	150	107	-43	35	10.9	24.1
1	1000	300	200	20	270	M16	2	200	060	017	-43	45	10.9	34.1
1	1000	300	200	20	0	M16	2	930	285	287	2	0	10.9	-10.9
1	1000	300	200	20	90	M14	1	830	255	197	-58	30	10.9	19.1
1	1000	300	200	20	180	M14	0			107			.	.
1	1000	300	200	20	270	M14	2	1230	015	017	2	30	10.9	19.1
1	1000	300	200	20	0	M14	4	830	255	287	32	0	10.9	-10.9
1	1000	300	200	20	90	50	2	830	255	197	-58	35	10.9	24.1
1	1000	300	200	20	180	50	3	400	120	107	-13	30	10.9	19.1
1	1000	300	200	20	270	50	2	230	075	017	-58	30	10.9	19.1
1	1000	300	200	20	0	50	3	930	285	287	2	0	10.9	-10.9
1	1000	300	200	40	90	M16	1	820	250	197	-53	30	10.9	19.1
1	1000	300	200	40	180	M16	2	400	120	107	-13	30	10.9	19.1
1	1000	300	200	40	270	M16	3	1240	020	017	-3	30	10.9	19.1
1	1000	300	200	40	0	M16	3	930	285	287	2	0	10.9	-10.9
1	1000	300	200	40	90	M14	1	810	245	197	-48	25	10.9	22.3
1	1000	300	200	40	180	M14	2	520	160	107	-53	30	10.9	19.1
1	1000	300	200	40	270	M14	1	210	065	017	-48	25	10.9	14.1
1	1000	300	200	40	0	M14	3	930	285	287	2	15	10.9	4.1
1	1000	300	200	40	90	50	1	800	240	197	-43	30	10.9	19.1
1	1000	300	200	40	180	50	2	345	112	107	-5	30	10.9	19.1
1	1000	300	200	40	270	50	2	1240	020	017	-3	30	10.9	19.1
1	1000	300	200	40	0	50	3	920	280	287	7	0	10.9	-10.9
1	1000	300	200	80	90	M16	1	810	245	197	-48	25	10.9	14.1
1	1000	300	200	80	180	M16	2	340	110	107	-3	25	10.9	14.1
1	1000	300	200	80	270	M16	2	1230	015	017	2	30	10.9	19.1
1	1000	300	200	80	0	M16	4	810	245	287	42	0	10.9	-10.9
1	1000	300	200	80	90	M14	2	700	210	197	-13	65	10.9	54.1
1	1000	300	200	80	180	M14	2	400	120	107	-13	30	10.9	19.1
1	1000	300	200	80	270	M14	3	1240	020	017	-3	35	10.9	24.1

1	1000	300	200	80	0	M14	3	830	255	287	32	0	10.9	-10.9
1	1000	300	200	80	90	50	2	830	255	197	-58	25	10.9	14.1
1	1000	300	200	80	180	50	1	520	160	107	-53	25	10.9	14.1
1	1000	300	200	80	270	50	2	1240	020	017	-3	40	10.9	29.1
1	1000	300	200	80	0	50	2	820	250	287	37	50	10.9	39.1

1	1000	300	500	20	90	M16	1	820	250	197	-53	30	25.6	4.4
1	1000	300	500	20	180	M16	1	410	125	107	-18	35	25.6	9.4
1	1000	300	500	20	270	M16	2	1240	20	017	-3	45	25.6	19.4
1	1000	300	500	20	0	M16	1	1100	330	287	-43	45	25.6	19.4
1	1000	300	500	20	90	M14	2	700	210	197	-13	30	25.6	4.4
1	1000	300	500	20	180	M14	2	430	135	107	-28	35	25.6	9.4
1	1000	300	500	20	270	M14	3	100	30	017	-13	45	25.6	19.4
1	1000	300	500	20	0	M14	3	820	250	287	37	30	25.6	4.4
1	1000	300	500	20	90	50	3	700	210	197	-13	30	25.6	4.4
1	1000	300	500	20	180	50	3	410	155	107	-48	35	25.6	9.4
1	1000	300	500	20	270	50	3	1240	20	017	-3	40	25.6	14.4
1	1000	300	500	20	0	50	4	930	285	287	2	25	25.6	-.6
1	1000	300	500	40	90	M16	2	700	210	197	-17	30	25.6	4.4
1	1000	300	500	40	180	M16	2	400	120	107	-13	30	25.6	4.4
1	1000	300	500	40	270	M16	3	1240	20	017	-3	45	25.6	19.4
1	1000	300	500	40	0	M16	2	930	285	287	2	25	25.6	-.6
1	1000	300	500	40	90	M14	3	650	205	197	-8	30	25.6	4.4
1	1000	300	500	40	180	M14	3	420	130	107	-23	35	25.6	9.4
1	1000	300	500	40	270	M14	2	1240	20	017	-3	45	25.6	19.4
1	1000	300	500	40	0	M14	2	1100	330	287	-43	75	25.6	49.6
1	1000	300	500	40	90	50	4	650	205	197	-8	30	25.6	4.4
1	1000	300	500	40	180	50	3	420	130	107	-23	30	25.6	4.4
1	1000	300	500	40	270	50	4	1240	20	017	-3	45	25.6	19.4
1	1000	300	500	40	0	50	5	900	270	287	17	30	25.6	4.4
1	1000	300	500	80	90	M16	2	650	205	197	-8	25	25.6	-.6
1	1000	300	500	80	180	M16	2	355	115	107	-8	30	25.6	4.4
1	1000	300	500	80	270	M16	4	1230	015	017	2	45	25.6	19.4
1	1000	300	500	80	0	M16	2	930	285	287	2	15	25.6	-10.6
1	1000	300	500	80	90	M14	2	640	200	197	-3	20	25.6	-5.6
1	1000	300	500	80	180	M14	1	530	165	107	-58	30	25.6	4.4
1	1000	300	500	80	270	M14	3	1230	015	017	2	45	25.6	19.4
1	1000	300	500	80	0	M14	3	920	280	287	7	25	25.6	-.6
1	1000	300	500	80	90	50	3	630	195	197	2	25	25.6	-.6
1	1000	300	500	80	180	50	3	400	120	107	-13	30	25.6	4.4
1	1000	300	500	80	270	50	4	1230	015	017	2	45	25.6	19.4
1	1000	300	500	80	0	50	3	900	270	287	13	20	25.6	-5.6

1	1230	200	50	20	90	M16	2	740	230	189	-41	40	2.4	37.6
1	1230	200	50	20	180	M16	1	500	150	099	-51	40	2.4	37.6
1	1230	200	50	20	270	M16	2	200	060	009	-51	35	2.4	32.6
1	1230	200	50	20	0	M16	2	1040	320	279	-41	30	2.4	27.6
1	1230	200	50	20	90	M14	2	730	225	189	-36	40	2.4	37.6
1	1230	200	50	20	180	M14	1	500	150	099	-51	40	2.4	37.6
1	1230	200	50	20	270	M14	2	200	060	009	-51	40	2.4	37.6
1	1230	200	50	20	0	M14	2	1030	315	279	-46	40	2.4	37.6
1	1230	200	50	20	90	50C	1	800	240	189	-51	40	2.4	37.6
1	1230	200	50	20	180	50C	1	500	150	099	-51	35	2.4	32.6
1	1230	200	50	20	270	50C	2	1230	015	009	-6	40	2.4	37.6
1	1230	200	50	20	0	50C	1	1115	337	279	-57	40	2.4	37.6
1	1230	200	50	40	90	M16	4	700	210	189	-21	40	2.4	37.6
1	1230	200	50	40	180	M16	1	430	135	099	-36	30	2.4	27.6
1	1230	200	50	40	270	M16	2	1220	010	009	-1	30	2.4	27.6
1	1230	200	50	40	0	M16	2	1220	010	279	-91	40	2.4	37.6
1	1230	200	50	40	90	M14	2	740	230	189	-41	35	2.4	32.6
1	1230	200	50	40	180	M14	1	500	150	099	-51	30	2.4	27.6
1	1230	200	50	40	270	M14	5	1230	015	009	-6	40	2.4	37.6
1	1230	200	50	40	0	M14	2	1030	315	279	-36	40	2.4	37.6
1	1230	200	50	40	90	50C	1	800	240	189	-51	45	2.4	42.6
1	1230	200	50	40	180	50C	2	330	105	099	-6	40	2.4	37.6
1	1230	200	50	40	270	50C							2.4	.
1	1230	200	50	40	0	50C	1	1110	335	279	-56	45	2.4	42.6
1	1230	200	50	80	90	M16	1	730	225	189	-36	30	2.4	27.6
1	1230	200	50	80	180	M16	1	500	150	099	-51	20	2.4	17.6
1	1230	200	50	80	270	M16	2	1200	000	009	9	40	2.4	37.6
1	1230	200	50	80	0	M16	2	1030	315	279	-36	40	2.4	37.6
1	1230	200	50	80	90	M14	0						2.4	.
1	1230	200	50	80	180	M14	0						2.4	.
1	1230	200	50	80	270	M14	3	1215	007	009	1	45	2.4	42.6
1	1230	200	50	80	0	M14	2	1050	325	279	-46	45	2.4	42.6
1	1230	200	50	80	90	50C	1	750	235	189	-46	40	2.4	37.6
1	1230	200	50	80	180	50C	1	515	157	099	-58	20	2.4	17.6
1	1230	200	50	80	270	50C	1	220	070	009	-61	35	2.4	32.6
1	1230	200	50	80	0	50C	2	900	270	279	9	45	2.4	42.6
1	1230	200	200	20	90	M16	2	720	220	189	-31	45	9.4	35.6
1	1230	200	200	20	180	M16	1	500	150	099	-51	45	9.4	35.6
1	1230	200	200	20	270	M16	2	1220	010	009	-1	20	9.4	10.6
1	1230	200	200	20	0	M16	3	920	280	279	-1	30	9.4	20.6
1	1230	200	200	20	90	M14	1	800	240	189	-51	40	9.4	30.6
1	1230	200	200	20	180	M14	1	500	150	099	-51	35	9.4	25.6
1	1230	200	200	20	270	M14	3	1215	007	009	1	40	9.4	30.6
1	1230	200	200	20	0	M14	4	910	275	279	4	30	9.4	20.6
1	1230	200	200	20	90	50C	1	800	240	189	-51	45	9.4	35.6
1	1230	200	200	20	180	50C	2	920	280	099	179	40	9.4	30.6
1	1230	200	200	20	270	50C	3	1215	007	009	1	30	9.4	20.6
1	1230	200	200	20	0	50C	3	915	277	279	1	30	9.4	20.6
1	1230	200	200	40	90	M16	1	750	235	189	-46	40	9.4	30.6
1	1230	200	200	40	180	M16	1	500	150	099	-51	40	9.4	30.6
1	1230	200	200	40	270	M16	3	1220	010	009	-1	40	9.4	30.6
1	1230	200	200	40	0	M16	2	915	277	279	1	35	9.4	25.6
1	1230	200	200	40	90	M14	2	700	210	189	-21	30	9.4	20.6
1	1230	200	200	40	180	M14	1	500	150	099	-51	40	9.4	30.6
1	1230	200	200	40	270	M14	2	1215	007	009	1	30	9.4	20.6
1	1230	200	200	40	0	M14	2	1100	330	279	-51		9.4	
1	1230	200	200	40	90	50C	1	730	225	189	-36	45	9.4	35.6
1	1230	200	200	40	180	50C	2	330	105	099	-6	40	9.4	30.6
1	1230	200	200	40	270	50C	3	1215	007	009	1	30	9.4	20.6

1	1230	200	200	40	0	50C	2	915	277	279	1	30	9.4	20.6
1	1230	200	200	80	90	M16	1	715	217	189	-28	40	9.4	30.6
1	1230	200	200	80	180	M16	0						9.4	.
1	1230	200	200	80	270	M16	2	100	030	009	-21	60	9.4	50.6
1	1230	200	200	80	0	M16	1	1045	322	279	-33	50	9.4	40.6
1	1230	200	200	80	90	M14	1	800	240	189	-51	40	9.4	30.6
1	1230	200	200	80	180	M14	2	530	165	099	-66	50	9.4	40.6
1	1230	200	200	80	270	M14	3	1215	007	009	1	45	9.4	35.6
1	1230	200	200	80	0	M14	1	1030	315	279	-36	55	9.4	45.6
1	1230	200	200	80	90	50C	1	745	232	189	-43	45	9.4	35.6
1	1230	200	200	80	180	50C	1	500	150	099	-51	50	9.4	45.6
1	1230	200	200	80	270	50C	2	1215	007	009	1	40	9.4	30.6
1	1230	200	200	80	0	50C	2	900	270	279	9	30	9.4	20.6

1	1230	200	500	20	90	M16	1	800	240	189	-51	45	22.4	22.6
1	1230	200	500	20	180	M16	1	445	142	099	-43	45	22.4	22.6
1	1230	200	500	20	270	M16	2	1230	015	009	-6	45	22.4	22.6
1	1230	200	500	20	0	M16	1	1030	315	279	-36	60	22.4	37.6
1	1230	200	500	20	90	M14	1	900	270	189	-81	45	22.4	22.6
1	1230	200	500	20	180	M14	2	330	105	099	-6	45	22.4	22.6
1	1230	200	500	20	270	M14	2	1215	007	009	1	45	22.4	22.6
1	1230	200	500	20	0	M14	2	915	277	279	1	40	22.4	17.6
1	1230	200	500	20	90	50C	1	300	090	189	99	55	22.4	32.6
1	1230	200	500	20	180	50C	3	915	277	099	-178	45	22.4	22.6
1	1230	200	500	20	270	50C	3	1230	015	009	-6	45	22.4	22.6
1	1230	200	500	20	0	50C	3	915	277	279	1	40	22.4	17.6
1	1230	200	500	40	90	M16	1	745	232	189	-43	35	22.4	12.6
1	1230	200	500	40	180	M16	1	500	150	099	-51	30	22.4	7.6
1	1230	200	500	40	270	M16	3	1245	022	009	-13	50	22.4	27.6
1	1230	200	500	40	0	M16	1	1100	330	279	-51	45	22.4	22.6
1	1230	200	500	40	90	M14	1	800	240	189	-51	40	22.4	17.6
1	1230	200	500	40	180	M14	1	500	150	099	-51	40	22.4	17.6
1	1230	200	500	40	270	M14	2	1215	007	009	1	45	22.4	22.6
1	1230	200	500	40	0	M14	1	1045	322	279	-43	60	22.4	37.6
1	1230	200	500	40	90	50C	2	630	195	189	-6	30	22.4	7.6
1	1230	200	500	40	180	50C	2	345	112	099	-13	45	22.4	22.6
1	1230	200	500	40	270	50C	2	1230	015	009	-6	45	22.4	22.6
1	1230	200	500	40	0	50C	3	900	270	279	9	35	22.4	12.6
1	1230	200	500	80	90	M16	1	800	240	189	-51	45	22.4	22.6
1	1230	200	500	80	180	M16	1	500	150	099	-51	40	22.4	17.6
1	1230	200	500	80	270	M16	1	200	060	009	-51	50	22.4	27.6
1	1230	200	500	80	0	M16	1	1030	315	279	-36	60	22.4	37.6
1	1230	200	500	80	90	M14	2	800	240	189	-51	30	22.4	7.6
1	1230	200	500	80	180	M14	3	345	112	099	-13	40	22.4	17.6
1	1230	200	500	80	270	M14	2	1215	007	009	1	45	22.4	22.6
1	1230	200	500	80	0	M14	2	915	277	279	1	30	22.4	7.6
1	1230	200	500	80	90	50C	2	715	217	189	-28	30	22.4	7.6
1	1230	200	500	80	180	50C	1	445	144	099	-45	50	22.4	27.6
1	1230	200	500	80	270	50C	2	1215	007	009	1	50	22.4	27.6
1	1230	200	500	80	0	50C	3	900	270	279	9	30	22.4	7.6

1	1200	300	50	20	90	M16	0			194			2.3	.
1	1200	300	50	20	180	M16	1	500	150	104	-46	30	2.3	27.7
1	1200	300	50	20	270	M16	1	200	060	014	-46	30	2.3	27.7
1	1200	300	50	20	0	M16	1	1100	330	284	-46	30	2.3	27.7
1	1200	300	50	20	90	M14	1	800	240	194	-46	45	2.3	42.7
1	1200	300	50	20	180	M14	0						2.3	
1	1200	300	50	20	270	M14	1	215	67	014	-53	45	2.3	42.7
1	1200	300	50	20	0	M14	1	1100	330	284	-46	30	2.3	27.7

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1	1200	300	50	20	90	50C	1	800	240	194	-46	42	2.3	39.7
1	1200	300	50	20	180	50C	0			104			2.3	.
1	1200	300	50	20	270	50C	2	1245	022	014	-8	30	2.3	27.7
1	1200	300	50	20	0	50C	1	1115	337	284	-53	30	2.3	27.7
1	1200	300	50	40	90	M16	0			194			2.3	.
1	1200	300	50	40	180	M16	1	500	150	104	-46	30	2.3	27.7
1	1200	300	50	40	270	M16	2	1215	007	014	6	35	2.3	32.7
1	1200	300	50	40	0	M16	1	1100	330	284	-46	30	2.3	27.7
1	1200	300	50	40	90	M14	1			194			2.3	.
1	1200	300	50	40	180	M14	3	630	195	104	-1	75	2.3	72.7
1	1200	300	50	40	270	M14	3	1230	015	014	-1	30	2.3	27.7
1	1200	300	50	40	0	M14	2	830	255	284	29	45	2.3	42.7
1	1200	300	50	40	90	50C	1	815	247	194	-53	40	2.3	37.7
1	1200	300	50	40	180	50C	1	530	165	104	-61	30	2.3	27.7
1	1200	300	50	40	270	50C	2	1245	022	014	-8	30	2.3	27.7
1	1200	300	50	40	0	50C	1	1115	337	284	-53	40	2.3	37.7
1	1200	300	50	80	90	M16	1	800	240	194	-46	30	2.3	27.7
1	1200	300	50	80	180	M16	0			104			2.3	.
1	1200	300	50	80	270	M16	0			014			2.3	.
1	1200	300	50	80	0	M16	0			284			2.3	.
1	1200	300	50	80	90	M14	1	800	240	194	-46	30	2.3	27.7
1	1200	300	50	80	180	M14	0			104			2.3	.
1	1200	300	50	80	270	M14	1	215	067	014	-53	40	2.3	37.7
1	1200	300	50	80	0	M14	0			284			2.3	.
1	1200	300	50	80	90	50C	1	815	247	194	-53	30	2.3	27.7
1	1200	300	50	80	180	50C	0			104			2.3	.
1	1200	300	50	80	270	50C	1	215	067	014	-53	30	2.3	27.7
1	1200	300	50	80	0	50C	1	1100	330	284	-46	40	2.3	37.7
1	1200	300	200	20	90	M16	1	745	232	194	-38	40	9.2	30.8
1	1200	300	200	20	180	M16	0			104			9.2	.
1	1200	300	200	20	270	M16	0			014			9.2	.
1	1200	300	200	20	0	M16	0			284			9.2	.
1	1200	300	200	20	90	M14	0			194			9.2	.
1	1200	300	200	20	180	M14	1	345	112	104	-8	40	9.2	30.8
1	1200	300	200	20	270	M14	1	145	52	014	-38	45	9.2	35.8
1	1200	300	200	20	0	M14	1	300	090	284	-166	15	9.2	5.8
1	1200	300	200	20	90	50C	1	800	240	194	-46	45	9.2	35.8
1	1200	300	200	20	180	50C	0			104			9.2	.
1	1200	300	200	20	270	50C	0			014			9.2	.
1	1200	300	200	20	0	50C	2	930	285	284	-1	30	9.2	27.8
1	1200	300	200	40	90	M16	0			194			9.2	.
1	1200	300	200	40	180	M16	0			104			9.2	.
1	1200	300	200	40	270	M16	0			014			.	.
1	1200	300	200	40	0	M16	1	1100	330	284	-46	40	9.2	37.8
1	1200	300	200	40	90	M14	1	715	225	194	-31	40	9.2	37.8
1	1200	300	200	40	180	M14	0			104			9.2	.
1	1200	300	200	40	270	M14	0						9.2	
1	1200	300	200	40	0	M14	0						.	
1	1200	300	200	40	90	50C	1	800	240	194	-46	45	9.2	35.8
1	1200	300	200	40	180	50C	0			104			.	.
1	1200	300	200	40	270	50C	1	215	075	014	-61	40	9.2	30.8
1	1200	300	200	40	0	50C	1	315	105	284	179	30	9.2	20.8
1	1200	300	200	80	90	M16	0						9.2	.
1	1200	300	200	80	180	M16	0						9.2	.
1	1200	300	200	80	270	M16	1	200	060	014	-46	30	9.2	20.8
1	1200	300	200	80	0	M16	1	1230	015	284	-91	45	9.2	35.8
1	1200	300	200	80	90	M14	0						9.2	.
1	1200	300	200	80	180	M14	3	400	120	104	-16	30	9.2	20.8
1	1200	300	200	80	270	M14	0						9.2	.

~~CONFIDENTIAL~~ UNCLASSIFIED

1	1200	300	200	80	0	M14	1	1100	330	284	-46	45	9.2	35.8
1	1200	300	200	80	90	50C	0						9.2	.
1	1200	300	200	80	180	50C	1	400	120	104	-16	30	9.2	20.8
1	1200	300	200	80	270	50C	1	330	105	014	-91	40	9.2	30.8
1	1200	300	200	80	0	50C	1	1000	300	284	-16	60	9.2	50.8
1	1200	300	500	20	90	M16	0						22.0	.
1	1200	300	500	20	180	M16	1	500	150	104	-46	40	22.0	18.
1	1200	300	500	20	270	M16	1	215	067	014	-53	30	22.0	8.
1	1200	300	500	20	0	M16	1	1100	330	284	-46	55	22.0	33.
1	1200	300	500	20	90	M14	1	815	247	194	-53	45	22.0	23.
1	1200	300	500	20	180	M14	2	400	120	104	-16	45	22.0	23.
1	1200	300	500	20	270	M14	1	1245	022	014	-8	40	22.0	18.
1	1200	300	500	20	0	M14	1	130	045	284	-121	45	22.0	23.
1	1200	300	500	20	90	50C	2	645	202	194	-8	40	22.0	18.
1	1200	300	500	20	180	50C	1	500	150	104	-46	45	22.0	23.
1	1200	300	500	20	270	50C	2	1245	022	014	-8	45	22.0	23.
1	1200	300	500	20	0	50C	3	530	165	284	119	30	22.0	8.
1	1200	300	500	40	90	M16							22.0	.
1	1200	300	500	40	180	M16							22.0	.
1	1200	300	500	40	270	M16							22.0	.
1	1200	300	500	40	0	M16							22.0	.
1	1200	300	500	40	90	M14							22.0	.
1	1200	300	500	40	180	M14							22.0	.
1	1200	300	500	40	270	M14							22.0	.
1	1200	300	500	40	0	M14							22.0	.
1	1200	300	500	40	90	50C							22.0	.
1	1200	300	500	40	180	50C							22.0	.
1	1200	300	500	40	270	50C							22.0	.
1	1200	300	500	40	0	50C							22.0	.
1	1200	300	500	80	90	M16	1	700	210	194	-16	40	22.0	18.
1	1200	300	500	80	180	M16	1	400	120	104	-16	30	22.0	8.
1	1200	300	500	80	270	M16	2	1215	007	014	6	45	22.0	23.
1	1200	300	500	80	0	M16	2	900	270	284	14	30	22.0	8.
1	1200	300	500	80	90	M14	2	615	187	194	6	30	22.0	8.
1	1200	300	500	80	180	M14	2	400	120	104	-16	40	22.0	18.
1	1200	300	500	80	270	M14	1	315	097	014	-83	40	22.0	18.
1	1200	300	500	80	0	M14	2	1200	000	284	-74	70	22.0	48.
1	1200	300	500	80	90	50C	3	645	202	194	-8	40	22.0	18.
1	1200	300	500	80	180	50C	1	515	157	104	-53	45	22.0	23.
1	1200	300	500	80	270	50C	3	1230	015	014	-1	45	22.0	23.
1	1200	300	500	80	0	50C	3	900	270	284	14	45	22.0	23.

1	1400	200	50	20	90	M16	0			188			2.0	.
1	1400	200	50	20	180	M16	0			98			2.0	.
1	1400	200	50	20	270	M16	0			008			2.0	.
1	1400	200	50	20	0	M16	1	1030	315	278	-37	5	2.0	3.
1	1400	200	50	20	90	M14	1	800	240	188	-52	65	2.0	63.
1	1400	200	50	20	180	M14	1	300	90	98	8	80	2.0	78.
1	1400	200	50	20	270	M14	1	200	60	8	-52	0	2.0	-2.
1	1400	200	50	20	0	M14	1	1050	325	278	-47	0	2.0	-2.
1	1400	200	50	20	90	50	0			188			2.0	
1	1400	200	50	20	180	50	0			98			2.0	.
1	1400	200	50	20	270	50	2	220	70	8	-62	20	2.0	18.
1	1400	200	50	20	0	50	2	1100	330	278	-52	30	2.0	28.
1	1400	200	50	40	90	M16	2	740	260	188	-72	30	2.0	28.
1	1400	200	50	40	180	M16	0			98			.	.
1	1400	200	50	40	270	M16	2	140	50	8	-42	20	2.0	18.
1	1400	200	50	40	0	M16	2	1020	310	278	-32	35	2.0	33.
1	1400	200	50	40	90	M14	2	800	240	188	-52	30	2.0	28.
1	1400	200	50	40	180	M14	1	500	150	98	-52	25	2.0	23.
1	1400	200	50	40	270	M14	2	200	60	8	-52	20	2.0	18.
1	1400	200	50	40	0	M14	3	500	150	278	128	75	2.0	73.
1	1400	200	50	40	90	50	1	820	250	188	-62	30	2.0	28.
1	1400	200	50	40	180	50	2	320	100	98	-2	30	2.0	28.
1	1400	200	50	40	270	50	2	1220	10	8	-2	30	2.0	28.
1	1400	200	50	40	0	50	1	1100	330	278	-52	30	2.0	28.
1	1400	200	50	80	90	M16	1	740	260	188	-72	25	2.0	23.
1	1400	200	50	80	180	M16	0			98			.	.
1	1400	200	50	80	270	M16	1	130	45	8	-37	25	2.0	23.
1	1400	200	50	80	0	M16	2	1030	315	278	-37	30	2.0	28.
1	1400	200	50	80	90	M14	1	750	265	188	-77	25	2.0	23.
1	1400	200	50	80	180	M14	1	450	175	98	-77	15	2.0	13.
1	1400	200	50	80	270	M14	3	1220	10	8	-2	35	2.0	33.
1	1400	200	50	80	0	M14	2	1040	320	278	-42	35	2.0	33.
1	1400	200	50	80	90	50	2	800	240	188	-52	30	2.0	28.
1	1400	200	50	80	180	50	1	500	150	98	-52	15	2.0	13.
1	1400	200	50	80	270	50	2	1215	8	8	0	30	2.0	28.
1	1400	200	50	80	0	50	2	910	275	278	3	0	2.0	-2.

1	1400	200	200	20	90	M16	1	750	235	188	-48	30	8.0	22.
1	1400	200	200	20	180	M16	1	500	150	98	-52	30	8.0	22.
1	1400	200	200	20	270	M16	2	1240	20	8	-12	50	8.0	42.
1	1400	200	200	20	0	M16	1	1040	320	278	-42	50	8.0	42.
1	1400	200	200	20	90	M14	2	750	235	188	-47	45	8.0	37.
1	1400	200	200	20	180	M14	2	500	150	98	-52	45	8.0	37.
1	1400	200	200	20	270	M14	2	200	60	8	-52	45	8.0	37.
1	1400	200	200	20	0	M14	2	1010	305	278	-27	15	8.0	7.
1	1400	200	200	20	90	50	2	800	240	188	-52	40	8.0	32.
1	1400	200	200	20	180	50	3	520	160	98	-62	40	8.0	32.
1	1400	200	200	20	270	50	3	1240	20	8	-12	25	8.0	17.
1	1400	200	200	20	0	50	3	1100	330	278	-52	40	8.0	32.
1	1400	200	200	40	90	M16	1	745	232	188	-44	25	8.0	17.
1	1400	200	200	40	180	M16	1	450	140	98	-42	30	8.0	22.
1	1400	200	200	40	270	M16	1	200	60	8	-52	20	8.0	12.
1	1400	200	200	40	0	M16	2	1040	320	278	-42	0	8.0	-8.
1	1400	200	200	40	90	M14	1	800	240	188	-52	30	8.0	22.
1	1400	200	200	40	180	M14	4	330	105	98	-7	35	8.0	27.
1	1400	200	200	40	270	M14	2	120	40	8	-32	55	8.0	47.
1	1400	200	200	40	0	M14	5	1000	300	278	-22	50	8.0	42.
1	1400	200	200	40	90	50	2	800	240	188	-52	35	8.0	27.
1	1400	200	200	40	180	50	3	330	105	98	-7	30	8.0	22.
1	1400	200	200	40	270	50	3	1220	10	8	-2	25	8.0	17.

1	1400	200	200	40	0	50	2	1020	310	278	-32	45	8.0	37.
1	1400	200	200	80	90	M16	1	840	260	188	-72	25	8.0	17.
1	1400	200	200	80	180	M16	1	500	150	98	-52	20	8.0	12.
1	1400	200	200	80	270	M16	3	1220	10	8	-2	30	8.0	22.
1	1400	200	200	80	0	M16	1	1020	310	278	-32	50	8.0	42.
1	1400	200	200	80	90	M14	2	820	250	188	-62	30	8.0	22.
1	1400	200	200	80	180	M14	1	500	150	98	-52	20	8.0	12.
1	1400	200	200	80	270	M14	3	1220	10	8	-2	35	8.0	27.
1	1400	200	200	80	0	M14	1	1030	315	278	-37	50	8.0	42.
1	1400	200	200	80	90	50	2	740	230	188	-42	40	8.0	32.
1	1400	200	200	80	180	50	3	340	110	98	-12	30	8.0	22.
1	1400	200	200	80	270	50	3	200	60	8	-52	40	8.0	32.
1	1400	200	200	80	0	50	3	900	270	278	8	30	8.0	22.

1	1400	200	500	20	90	M16	1	740	230	188	-42	40	19.4	20.6
1	1400	200	500	20	180	M16	0			98			19.4	
1	1400	200	500	20	270	M16	1	210	65	8	-57	40	19.4	20.6
1	1400	200	500	20	0	M16	1	1000	300	278	-22	45	19.4	25.6
1	1400	200	500	20	90	M14	2	650	205	188	-17	45	19.4	25.6
1	1400	200	500	20	180	M14	1	540	170	98	-72	35	19.4	15.6
1	1400	200	500	20	270	M14	1	200	60	8	-52	55	19.4	35.6
1	1400	200	500	20	0	M14	4	920	280	278	-2	0	19.4	-19.4
1	1400	200	500	20	90	50	3	640	200	188	-12	30	19.4	10.6
1	1400	200	500	20	180	50	2	500	150	98	-52	55	19.4	35.6
1	1400	200	500	20	270	50	4	1220	10	8	-2	30	19.4	10.6
1	1400	200	500	20	0	50	3	910	275	278	3	15	19.4	-4.4
1	1400	200	500	40	90	M16	1	800	240	188	-52	35	19.4	15.6
1	1400	200	500	40	180	M16	1	525	162	98	-64	35	19.4	15.6
1	1400	200	500	40	270	M16	1	150	55	8	-47	50	19.4	30.6
1	1400	200	500	40	0	M16	1	1020	310	278	-32	40	19.4	20.6
1	1400	200	500	40	90	M14	1	750	235	188	-47	35	19.4	15.6
1	1400	200	500	40	180	M14	1	550	175	98	-77	40	19.4	20.6
1	1400	200	500	40	270	M14	1	210	65	8	-57	60	19.4	40.6
1	1400	200	500	40	0	M14	1	1050	325	278	-47	50	19.4	30.6
1	1400	200	500	40	90	50	2	640	200	188	-12	30	19.4	10.6
1	1400	200	500	40	180	50	2	500	150	98	-52	50	19.4	30.6
1	1400	200	500	40	270	50	3	1230	15	8	-7	35	19.4	15.6
1	1400	200	500	40	0	50	2	950	295	278	-23	30	19.4	10.6
1	1400	200	500	80	90	M16	1	730	225	188	-37	35	19.4	15.6
1	1400	200	500	80	180	M16	2	350	115	98	-17	30	19.4	10.6
1	1400	200	500	80	270	M16	3	1220	10	8	-2	45	19.4	25.6
1	1400	200	500	80	0	M16	1	940	290	278	-12	60	19.4	40.6
1	1400	200	500	80	90	M14	2	710	215	188	-27	20	19.4	.6
1	1400	200	500	80	180	M14	1	500	150	98	-52	30	19.4	10.6
1	1400	200	500	80	270	M14	2	1220	10	8	-2	45	19.4	25.6
1	1400	200	500	80	0	M14	1	920	280	278	-2	35	19.4	15.6
1	1400	200	500	80	90	50	2	620	190	188	-2	15	19.4	-4.4
1	1400	200	500	80	180	50	2	340	110	98	-12	30	19.4	10.6
1	1400	200	500	80	270	50	4	1220	10	8	-2	45	19.4	25.6
1	1400	200	500	80	0	50	2	830	255	278	23	30	19.4	10.6

(U) SPECIAL TEST DATA

M	500	300	025	020	090	M14	1	215	067	202	135	45	2.7	42.3
M	500	300	025	020	180	M14	3	330	105	112	7	15	2.7	12.3
M	500	300	025	020	270	M14	2	1245	022	022	0	15	2.7	12.3
M	500	300	025	020	000	M14	2	945	292	292	0	15	2.7	12.3
M	500	300	050	020	090	M14	1	815	247	202	-45	45	5.3	39.7
M	500	300	050	020	180	M14	2	345	112	112	0	30	5.3	24.7
M	500	300	050	020	270	M14	2	100	030	022	-8	15	5.3	9.7
M	500	300	050	020	000	M14	3	945	292	292	0	0	5.3	-5.3
M	500	300	075	020	090	M14	2	830	255	202	-53	45	7.6	37.4
M	500	300	075	020	180	M14	3	400	120	112	-8	30	7.6	22.4
M	500	300	075	020	270	M14	3	100	030	022	-8	30	7.6	22.4
M	500	300	075	020	000	M14	3			292		90	7.6	82.4
M	500	300	100	020	090	M14	2	800	240	202	-38	45	10.1	34.9
M	500	300	100	020	180	M14	3	400	120	112	-8	30	10.1	19.9
M	500	300	100	020	270	M14	3	100	030	022	-8	30	10.1	19.9
M	500	300	100	020	000	M14	3	1000	330	292	-38	15	10.1	4.9
M	500	300	150	020	090	M14	2	745	232	202	-30	45	15.2	29.8
M	500	300	150	020	180	M14	3	400	120	112	-8	30	15.2	14.8
M	500	300	150	020	270	M14	3	115	037	022	-15	40	15.2	24.8
M	500	300	150	020	000	M14	2	945	292	292	0	30	15.2	14.8
M	500	300	200	020	090	M14	3	700	210	202	-8	40	20.3	19.7
M	500	300	200	020	180	M14	3	400	120	112	-8	30	20.3	9.7
M	500	300	200	020	270	M14	3	1215	007	022	15	0	20.3	-20.3
M	500	300	200	020	000	M14	3	945	292	292	0	30	20.3	9.7
M	500	300	300	020	090	M14	3	700	210	202	-8	40	31.0	9.0
M	500	300	300	020	180	M14	3	415	127	112	-15	50	31.0	19.0
M	500	300	300	020	270	M14	3	100	030	022	-8	45	31.0	14.0
M	500	300	300	020	000	M14	2	930	285	292	13	30	31.0	-1.0
M	500	300	500	020	090	M14	2	700	210	202	-8	40	42.8	-2.8
M	500	300	500	020	180	M14	3	430	135	112	-13	50	42.8	7.2
M	500	300	500	020	270	M14	3	100	030	022	-8	60	42.8	17.2
M	500	300	500	020	000	M14	2	945	292	292	0	30	42.8	-12.8
N													.	.
O	1000	100	200	080	090	M16	1	830	255	186	-69	0	11.3	-11.3
O	1000	100	200	080	180	M16	1	800	240	096	-144	0	11.3	-11.3
O	1000	100	200	080	270	M16	3	1200	360	006	6	40	11.3	28.7
O	1000	100	200	080	000	M16	3	900	270	276	6	40	11.3	28.7
O	1000	100	200	080	090	M1	2	640	200	186	-14	0	11.3	-11.3
O	1000	100	200	080	180	M1	3	330	105	096	-9	25	11.3	13.7
O	1000	100	200	080	270	M1	4	1215	007	006	-1	40	11.3	28.7
O	1000	100	200	080	000	M1	2	900	270	276	6	30	11.3	18.7
O	1000	100	200	080	090	M14	1	720	220	186	-34	45	11.3	33.7
O	1000	100	200	080	180	M14	3	330	105	096	-9	30	11.3	18.7
O	1000	100	200	080	270	M14	3	1220	010	006	-4	40	11.3	28.7
O	1000	100	200	080	000	M14	2	900	270	276	6	50	11.3	38.7
O	1000	100	200	100	090	M14	2	700	210	186	-24	45	11.3	33.7
O	1000	100	200	100	180	M14	2	330	105	096	-9	30	11.3	18.7
O	1000	100	200	100	270	M14	2	1215	007	006	-1	40	11.3	28.7
O	1000	100	200	100	000	M14	2	900	270	276	6	60	11.3	48.7
O	1000	100	050	100	090	M14	2	730	225	186	-39	50	2.9	47.1
O	1000	100	050	100	180	M14	2	500	150	096	-54	10	2.9	7.1
O	1000	100	050	100	270	M14	3	1210	005	006	1	40	2.9	37.1
O	1000	100	050	100	000	M14	2	900	270	276	6	70	2.9	67.1
O	1000	100	050	080	090	M14	2	740	230	186	-44	30	2.9	27.1
O	1000	100	050	080	180	M14	2	500	150	096	-54	15	2.9	12.1
O	1000	100	050	080	270	M14	1	200	060	006	-54	45	2.9	42.1
O	1000	100	050	080	000	M14	2	1030	315	276	-39		.	.
O	1000	100	500	080	090	M14	2	620	190	186	-4	10	26.5	-16.5
O	1000	100	500	080	180	M14	2	350	115	096	-19		.	.
O	1000	100	500	080	270	M14	2	1200	360	006	6	45	26.5	18.5

0	1000	100	500	080	000	M14	2	850	265	276	11	45	26.5	18.5
0	1000	100	500	100	090	M14	1	730	235	186	-49	50	26.5	23.5
0	1000	100	500	100	180	M14	1	515	157	096	-61	40	26.5	13.5
0	1000	100	500	100	270	M14	1	200	060	006	-54	30	26.5	3.5
0	1000	100	500	100	000	M14	2	815	247	276	29	45	26.5	18.5
0	1000	100	200	080	090	M60	3	645	202	186	-16	45	11.3	33.7
0	1000	100	200	080	000	M60	2	745	232	096	-136	60	11.3	48.7
0	1000	100	200	080	270	M60	3	1230	015	006	-9	40	11.3	28.7
0	1000	100	200	080	180	M60	2	445	142	276	134	30	11.3	18.7
0	1000	100	200	080	090	M60	5	700	210	186	-24	45	11.3	33.7
0	1000	100	200	080	000	M60	9	900	270	096	-174	60	11.3	48.7
0	1000	100	200	080	270	M60	1	1230	015	006	-9	30	11.3	18.7
0	1000	100	200	080	180	M60	M	200	060	276	144	45	11.3	33.7
0	1000	100	200	080	090	50C	3	1200	360	186	-174	0	11.3	-11.3
0	1000	100	200	080	000	50C	3	900	270	096	-174	35	11.3	23.7
0	1000	100	200	080	270	50C	4	1215	007	006	-1	30	11.3	18.7
0	1000	100	200	080	180	50C	3	315	097	276	179	25	11.3	13.7
0	1000	100	200	080	090	50C	2	1145	352	186	-166	20	11.3	8.7
0	1000	100	200	080	000	50C	G	845	262	096	-166	40	11.3	28.7
0	1000	100	200	080	270	50C	G	1245	022	006	-16	40	11.3	28.7
0	1000	100	200	080	180	50C	G	315	097	276	179	30	11.3	18.7
0	1000	100	200	080	090	K56	1	710	215	186	-29	20	11.3	8.7
0	1000	100	200	080	000	K56	3	900	270	096	-174	30	11.3	18.7
0	1000	100	200	080	270	K56	2	115	037	006	-29	45	11.3	33.7
0	1000	100	200	080	180	K56	1	400	120	276	156	15	11.3	3.7
0	1000	100	200	080	090	762	1	700	210	186	-24	40	11.3	28.7
0	1000	100	200	080	000	762	2	250	085	096	11	35	11.3	23.7
0	1000	100	200	080	270	762	4	130	045	006	-39	35	11.3	23.7
0	1000	100	200	080	180	762	3	315	097	276	179	25	11.3	13.7
0	1000	100	200	080	090	125	2	700	210	186	-24	45	11.3	33.7
0	1000	100	200	080	000	125	3	900	270	096	-174	35	11.3	23.7
0	1000	100	200	080	270	125	3	1230	015	006	-9	35	11.3	23.7
0	1000	100	200	080	180	125	1	445	142	276	134	25	11.3	13.7
0	1000	100	200	080	090	20M	3	1155	357	186	-161	15	11.3	3.7
0	1000	100	200	080	000	20M	3	245	082	096	14	30	11.3	18.7
0	1000	100	200	080	270	20M	2	1245	022	006	-14	35	11.3	23.7
0	1000	100	200	080	180	20M	3	330	105	276	171	25	11.3	13.7
0	1000	100	200	080	090	23M	3	1150	355	186	-169	15	11.3	3.7
0	1000	100	200	080	000	23M	3	855	267	096	-171	35	11.3	23.7
0	1000	100	200	080	270	23M	3	1230	015	006	-9	35	11.3	23.7
0	1000	100	200	080	180	23M	3	315	097	276	179	20	11.3	8.7
0	1200	200	200	080	090	50C	2	730	225	190	-35	30	9.4	20.6
0	1200	200	200	080	000	50C	4	930	285	280	-5	15	9.4	5.6
0	1200	200	200	080	270	50C	2	1245	022	010	-12	30	9.4	20.6
0	1200	200	200	080	180	50C	1	500	150	100	-50	15	9.4	5.6
0	1200	200	200	080	090	K56	1	710	215	190	-25	15	9.4	5.6
0	1200	200	200	080	000	K56	2	930	285	280	-5	45	9.4	35.6
0	1200	200	200	080	270	K56	2	1215	007	010	3	45	9.4	35.6
0	1200	200	200	080	180	K56	1	425	132	100	-32	60	9.4	50.6
0	1200	200	200	080	090	762	2	700	210	190	-20	0	9.4	-9.4
0	1200	200	200	080	000	762	4	800	240	280	40	15	9.4	5.6
0	1200	200	200	080	270	762	M	100	030	010	-20	30	9.4	20.6
0	1200	200	200	080	180	762	1	445	142	100	-42	15	9.4	5.6
0	1200	200	200	080	090	125	2	730	225	190	-35	30	9.4	20.6
0	1200	200	200	080	000	125	2	900	270	280	10	60	9.4	50.6
0	1200	200	200	080	270	125	3	1250	025	010	-15	30	9.4	20.6
0	1200	200	200	080	180	125	2	445	142	100	-42	25	9.4	15.6
0	1400	200	200	080	090	M16	0			188			8.0	.
0	1400	200	200	080	000	M16	2	945	292	278	-14	50	8.0	42.0
0	1400	200	200	080	270	M16	1	200	060	008	-52	20	8.0	12.0

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O	1400	200	200	080	180	M16	0			098			8.0	.
O	1400	200	200	080	090	M1	1	730	225	188	-37	20	8.0	12.0
O	1400	200	200	080	000	M1	3	945	292	278	-14	0	8.0	-8.0
O	1400	200	200	080	270	M1	1	200	060	008	-52	15	8.0	7.0
O	1400	200	200	080	180	M1	1	430	135	098	-37	15	8.0	7.0
O	1400	200	200	080	090	M14	1	735	227	188	-39	15	8.0	7.0
O	1400	200	200	080	000	M14	1	945	292	278	-14	60	8.0	52.0
O	1400	200	200	080	270	M14	1	215	067	008	-59	15	8.0	7.0
O	1400	200	200	080	180	M14	1	445	142	098	-44	15	8.0	7.0
O	1400	200	200	080	090	M60	1	705	212	188	-24	30	8.0	22.0
O	1400	200	200	080	000	M60	2	930	285	278	-7	50	8.0	42.0
O	1400	200	200	080	270	M60	2	400	120	008	-112	40	8.0	32.0
O	1400	200	200	080	180	M60	1	430	135	098	-37	15	8.0	7.0
O	1400	200	200	080	090	50C	2	730	225	188	-37	35	8.0	27.0
O	1400	200	200	080	000	50C	3	900	270	278	8	0	8.0	-8.0
O	1400	200	200	080	270	50C	2	1245	022	008	-14	30	8.0	22.0
O	1400	200	200	080	180	50C	1	700	210	098	-112	20	8.0	12.0
O	1400	200	200	080	090	K56	0			188			8.0	.
O	1400	200	200	080	000	K56	2	900	270	278	8	45	8.0	37.0
O	1400	200	200	080	270	K56	1	100	030	008	-22	30	8.0	22.0
O	1400	200	200	080	180	K56	1	415	127	098	-129	15	8.0	7.0
O	1400	200	200	080	090	762	3	700	210	188	-22		8.0	.
O	1400	200	200	080	000	762	4	900	270	278	8	0	8.0	-8.0
O	1400	200	200	080	270	762	2	1250	025	008	-17	30	8.0	22.0
O	1400	200	200	080	180	762	2	430	135	098	-37	0	8.0	-8.0
O	1400	200	200	080	090	125	2	730	225	188	-37	35	8.0	27.0
O	1400	200	200	080	000	125	2	900	270	278	8	45	8.0	37.0
O	1400	200	200	080	270	125	3	1230	015	008	-7	30	8.0	22.0
O	1400	200	200	080	180	125	2	445	142	098	-52	15	8.0	7.0
O	1400	200	200	080	090	23M	2	730	225	188	-37	15	8.0	7.0
O	1400	200	200	080	000	23M	3	900	270	278	8	0	8.0	-8.0
O	1400	200	200	080	270	23M	3	1230	015	008	-7	30	8.0	22.0
O	1400	200	200	080	180	23M	2	315	097	098	1	20	8.0	12.0
P													.	.
Q	500	200	200	080	090	M14	3	630	195	202	7	10	20.3	-10.3
Q	500	200	200	080	180	M14	2	400	120	112	-8	30	20.3	9.7
Q	500	200	200	080	270	M14	2	1230	015	022	7	35	20.3	14.7
Q	500	200	200	080	000	M14	2	900	270	292	22	15	20.3	-5.3
Q	500	200	200	080	090	M14	1	620	190	202	12	15	20.3	-5.3
Q	500	200	200	080	180	M14	3	410	125	112	-13	20	20.3	-.3
Q	500	200	200	080	270	M14	3	1240	020	022	2	35	20.3	-14.7
Q	500	200	200	080	000	M14	2	940	290	292	2	30	20.3	-9.7
R	1000	100	200	020	090	50C	2			188			11.3	.
R	1000	100	200	020	270	50C	3			008			11.3	.
R	1000	100	200	020	090	50C	1	700	210	188	-22	30	11.3	18.7
R	1000	100	200	020	270	50C	3			008			11.3	.
R	1000	100	200	020	090	50C	1	615	187	188	1	30	11.3	18.7
R	1000	100	200	020	270	50C	3			008			11.3	.
R	1000	100	200	020	090	50C	0			188			11.3	.
R	1000	100	200	020	270	50C	3			008			11.3	.
R	1000	100	200	020	090	M60	0			188			11.3	.
R	1000	100	200	020	270	M60	1	1220	010	008	-2	30	11.3	18.7
R	1000	100	200	020	090	M60	0			188			11.3	.
R	1000	100	200	020	270	M60	1	1230	015	008	-7	30	11.3	18.7
R	1000	100	200	020	090	M60	0			188			11.3	.
R	1000	100	200	020	270	M60	2	1230	015	008	-7	20	11.3	8.7
R	1000	100	200	020	090	M60	0			188			11.3	.
R	1000	100	200	020	270	M60	2	1230	015	008	-7	20	11.3	8.7
S													.	.
T	500	300	050	020	090	M14	1			211			4.9	.

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T	500	300	050	020	180	M14	2	400	120	121	1	30	4.9	25.1
T	500	300	050	020	270	M14	3	115	037	031	-6	35	4.9	30.1
T	500	300	050	020	000	M14	2	950	295	301	6	15	4.9	10.1
T	500	300	050	020	090	50C	1	850	265	211	-54	30	4.9	25.1
T	500	300	050	020	180	50C	2	400	120	121	1	30	4.9	25.1
T	500	300	050	020	270	50C	2	100	030	031	1	35	4.9	30.1
T	500	300	050	020	000	50C	2	950	295	301	6	5	4.9	.1
T	500	300	050	080	090	M14	2	700	210	211	1	10	4.9	5.1
T	500	300	050	080	180	M14	1	515	157	121	-36	10	4.9	5.1
T	500	300	050	080	270	M14	2	100	030	031	1	30	4.9	25.1
T	500	300	050	080	000	M14	2	1000	300	301	1	25	4.9	20.1
T	500	300	050	080	090	50C	2	700	210	211	1	10	4.9	5.1
T	500	300	050	080	180	50C	2	400	120	121	1	20	4.9	15.1
T	500	300	050	080	270	50C	1	230	075	031	-44	30	4.9	25.1
T	500	300	050	080	000	50C	2	1000	300	301	1	20	4.9	15.1
T	500	300	200	020	090	M14	3	700	210	211	1	35	19.0	16.0
T	500	300	200	020	180	M14	2	400	120	121	1	60	19.0	41.0
T	500	300	200	020	270	M14	3	1210	005	031	26	20	19.0	1.0
T	500	300	200	020	000	M14	3	950	295	301	6	30	19.0	11.0
T	500	300	200	020	090	50C	1	730	225	211	-14	35	19.0	16.0
T	500	300	200	020	180	50C	2	330	105	121	16	35	19.0	16.0
T	500	300	200	020	270	50C	2	115	037	031	-6	35	19.0	16.0
T	500	300	200	020	000	50C	2	940	290	301	11	30	19.0	11.0
T	500	300	200	080	090	M14	2	650	205	211	6	20	19.0	1.0
T	500	300	200	080	180	M14	3	430	135	121	-14	30	19.0	11.0
T	500	300	200	080	270	M14	2	110	035	031	-4	40	19.0	21.0
T	500	300	200	080	000	M14	3	940	290	301	11	30	19.0	11.0
T	500	300	200	080	090	50C	2	650	205	211	6	20	19.0	1.0
T	500	300	200	080	180	50C	2	410	125	121	-4	25	19.0	6.0
T	500	300	200	080	270	50C	2	110	035	031	-4	40	19.0	21.0
T	500	300	200	080	000	50C	2	930	285	301	16	30	19.0	11.0
T	500	300	200	080	090	K56	2	700	210	211	1	30	19.0	11.0
T	500	300	200	080	180	K56	3	400	120	121	1	25	19.0	6.0
T	500	300	200	080	270	K56	3	110	035	031	-4	30	19.0	11.0
T	500	300	200	080	000	K56	1	330	105	301	-164	30	19.0	11.0
T	1000	300	050	020	090	M14	1	815	247	197	-50	30	2.7	27.3
T	1000	300	050	020	180	M14	1	500	150	107	-43	30	2.7	27.3
T	1000	300	050	020	270	M14	2	215	067	017	-50	30	2.7	27.3
T	1000	300	050	020	000	M14	4	340	110	287	177	0	2.7	-2.7
T	1000	300	050	020	090	50C	1	815	247	197	-50	30	2.7	27.3
T	1000	300	050	020	180	50C	1	500	150	107	-43	30	2.7	27.3
T	1000	300	050	020	270	50C	1	230	075	017	-52	15	2.7	12.3
T	1000	300	050	020	000	50C	2	920	280	287	7	10	2.7	7.3
T	1000	300	050	080	090	M14	1	800	240	197	-43	15	2.7	12.3
T	1000	300	050	080	180	M14	1	500	150	107	-43	5	2.7	2.3
T	1000	300	050	080	270	M14	2	1245	022	017	-5	20	2.7	17.3
T	1000	300	050	080	000	M14	1	700	210	287	77	35	2.7	32.3
T	1000	300	050	080	090	50C	1	800	240	197	-43	15	2.7	12.3
T	1000	300	050	080	180	50C	1	500	150	107	-43	10	2.7	7.3
T	1000	300	050	080	270	50C	2	1230	015	017	2	30	2.7	27.3
T	1000	300	050	080	000	50C	1	1100	330	287	-43	35	2.7	32.3
T	1000	300	200	020	090	M14	1	800	240	197	-43	30	10.9	19.1
T	1000	300	200	020	180	M14	3	330	105	107	2	30	10.9	19.1
T	1000	300	200	020	270	M14	2	230	075	017	-58	40	10.9	29.1
T	1000	300	200	020	000	M14	2	915	277	287	10	10	10.9	-.9
T	1000	300	200	020	090	50C	2	620	190	197	7	35	10.9	24.1
T	1000	300	200	020	180	50C	2	400	120	107	-13	25	10.9	14.1
T	1000	300	200	020	270	50C	2	130	045	017	-28	70	10.9	59.1
T	1000	300	200	020	000	50C	2	920	280	287	7	10	10.9	-.9
T	1000	300	200	080	090	M14	2	730	225	197	-28	40	10.9	29.1

T	1000	300	200	080	180	M14	2	340	110	107	-3	25	10.9	14.1
T	1000	300	200	080	270	M14	2	1250	025	017	-8	30	10.9	19.1
T	1000	300	200	080	000	M14	3	930	285	287	2	30	10.9	19.1
T	1000	300	200	080	090	50C	1	745	232	197	-35	30	10.9	19.1
T	1000	300	200	080	180	50C	2	350	115	107	-8	25	10.9	14.1
T	1000	300	200	080	270	50C	2	100	030	017	-13	30	10.9	19.1
T	1000	300	200	080	000	50C	1	915	277	287	10	15	10.9	4.1
T	1000	300	200	080	090	K47	2	710	215	197	-18	10	10.9	-.9
T	1000	300	200	080	180	K47	2	400	120	107	-13	30	10.9	19.1
T	1000	300	200	080	270	K47	3	145	052	017	-35	35	10.9	24.1
T	1000	300	200	080	000	K47	3	920	280	287	7	10	10.9	-.9
T	1200	300	50	020	090	M14	1	800	240	194	-46	30	2.3	27.7
T	1200	300	50	020	000	M14	1	1100	330	284	-46	20	2.3	17.7
T	1200	300	50	020	270	M14	1	200	060	014	-46	0	2.3	-2.3
T	1200	300	50	020	180	M14	0			104			2.3	.
T	1200	300	50	020	090	50C	2	815	247	194	-53	30	2.3	27.7
T	1200	300	50	020	180	50C	1	515	157	104	-53	30	2.3	27.7
T	1200	300	50	020	270	50C	2	645	202	014	72	45	2.3	42.7
T	1200	300	50	020	000	50C	2	915	277	284	7	0	2.3	-2.3
T	1200	300	50	080	090	M14	1	800	240	194	-46	30	2.3	27.7
T	1200	300	50	080	000	M14	1	1100	330	284	-46	30	2.3	27.7
T	1200	300	50	080	270	M14	1	200	060	014	-46	15	2.3	12.7
T	1200	300	50	080	180	M14	1	530	165	104	-61	45	2.3	42.7
T	1200	300	50	080	090	50C	1	815	247	194	-53	30	2.3	27.7
T	1200	300	50	080	000	50C	2	1230	015	284	-91	30	2.3	27.7
T	1200	300	50	080	270	50C	1	500	150	014	-136	0	2.3	-2.3
T	1200	300	50	080	180	50C	2	915	277	104	-173	0	2.3	-2.3
T	1200	300	200	020	090	M14	3	645	202	194	-8	15	9.2	5.8
T	1200	300	200	020	000	M14	4	915	277	284	7	0	9.2	-9.2
T	1200	300	200	020	270	M14	4	1230	015	014	-1	30	9.2	20.8
T	1200	300	200	020	180	M14	3	400	120	104	-16	30	9.2	20.8
T	1200	300	200	020	090	50C	1	800	240	194	-46	40	9.2	30.8
T	1200	300	200	020	000	50C	2	915	277	284	7	15	9.2	5.8
T	1200	300	200	020	270	50C	2	1230	015	014	-1	30	9.2	20.8
T	1200	300	200	020	180	50C	2	330	105	104	-1	15	9.2	5.8
T	1200	300	200	080	090	M14	2	630	195	194	-1	0	9.2	-9.2
T	1200	300	200	080	000	M14	3	330	105	284	-179	15	9.2	5.8
T	1200	300	200	080	270	M14	3	1245	022	014	-8	30	9.2	20.8
T	1200	300	200	080	180	M14	3	900	270	104	-166	15	9.2	5.8
T	1200	300	200	080	090	50C	2	630	195	194	-1	15	9.2	5.8
T	1200	300	200	080	000	50C	2	330	105	284	-179	30	9.2	20.8
T	1200	300	200	080	270	50C	2	1230	015	014	-1	30	9.2	20.8
T	1200	300	200	080	180	50C	2	915	277	104	-173	15	9.2	5.8
T	500	300	50	020	090	M14	0			211			4.9	.
T	500	300	50	020	000	M14	1	1115	337	301	-36	10	4.9	5.1
T	500	300	50	020	270	M14	0			031			4.9	.
T	500	300	50	020	180	M14	2	400	120	121	1	30	4.9	25.1
T	500	300	50	020	090	50C	1	820	250	211	-39	30	4.9	25.1
T	500	300	50	020	000	50C	2	1000	300	301	1	60	4.9	55.1
T	500	300	50	020	270	50C	2	100	030	031	1	30	4.9	25.1
T	500	300	50	020	180	50C	2	400	120	121	1	30	4.9	25.1
T	500	300	50	080	090	M14	2	700	210	211	1	15	4.9	10.1
T	500	300	50	080	000	M14	2	950	295	301	6	30	4.9	25.1
T	500	300	50	080	270	M14	2	100	030	031	1	30	4.9	25.1
T	500	300	50	080	180	M14	2	400	120	121	1	15	4.9	10.1
T	500	300	50	080	090	50C	2	700	210	211	1	20	4.9	15.1
T	500	300	50	080	000	50C	2	1000	300	301	1	25	4.9	20.1
T	500	300	50	080	270	50C	2	100	030	031	1	30	4.9	25.1
T	500	300	50	080	180	50C	2	400	120	121	1	20	4.9	15.1
T	500	300	200	020	090	M14	2	700	210	211	1	30	19.0	11.0

T	500	300	200	020	000	M14	3	450	145	301	156	30	19.0	11.0
T	500	300	200	020	270	M14	4	115	037	031	-6	35	19.0	16.0
T	500	300	200	020	180	M14	5	400	120	121	1	30	19.0	11.0
T	500	300	200	020	090	50C	2	700	210	211	1	30	19.0	11.0
T	500	300	200	020	000	50C	2	950	295	301	6	30	19.0	11.0
T	500	300	200	020	270	50C	2	115	037	031	-6	30	19.0	11.0
T	500	300	200	020	180	50C	3	340	110	121	11	20	19.0	1.0
T	500	300	200	080	090	M14	3	710	215	211	-4	20	19.0	1.0
T	500	300	200	080	000	M14	3	950	295	301	6	35	19.0	16.0
T	500	300	200	080	270	M14	4	100	030	031	1	40	19.0	21.0
T	500	300	200	080	180	M14	3	400	120	121	1	20	19.0	1.0
T	500	300	200	080	090	50C	2	700	210	211	1	20	19.0	1.0
T	500	300	200	080	000	50C	2	945	292	301	9	30	19.0	11.0
T	500	300	200	080	270	50C	2	1115	337	031	54	35	19.0	16.0
T	500	300	200	080	180	50C	2	415	127	121	-6	30	19.0	11.0
T	1000	300	50	020	090	M14	1	830	255	197	-58	30	2.7	27.3
T	1000	300	50	020	000	M14	1	1100	330	287	-43	30	2.7	27.3
T	1000	300	50	020	270	M14	3	1230	015	017	2	30	2.7	27.3
T	1000	300	50	020	180	M14	1	500	150	107	-43	30	2.7	27.3
T	1000	300	50	020	090	50C	1	820	250	197	-53	30	2.7	27.3
T	1000	300	50	020	000	50C	2	940	290	287	-3	10	2.7	7.3
T	1000	300	50	020	270	50C	3	1240	020	017	-3	30	2.7	27.3
T	1000	300	50	020	180	50C	1	500	150	107	-43	30	2.7	27.3
T	1000	300	50	080	090	M14	1	800	240	197	-43	25	2.7	22.3
T	1000	300	50	080	000	M14	3	920	280	287	7	40	2.7	37.3
T	1000	300	50	080	270	M14	2	1240	020	017	-3	30	2.7	27.3
T	1000	300	50	080	180	M14	2	330	105	107	2	30	2.7	27.3
T	1000	300	50	080	090	50C	1	800	240	197	-43	30	2.7	27.3
T	1000	300	50	080	000	50C	2	930	285	287	2	0	2.7	-2.7
T	1000	300	50	080	270	50C	1	220	070	017	-53	20	2.7	17.3
T	1000	300	50	080	180	50C	2	330	105	107	2	20	2.7	17.3
T	1000	300	200	020	090	M14	2	800	240	197	-43	30	10.9	19.1
T	1000	300	200	020	000	M14	3	915	277	287	10	5	10.9	-5.9
T	1000	300	200	020	270	M14	4	1245	022	017	-5	30	10.9	19.1
T	1000	300	200	020	180	M14	3	330	105	107	2	30	10.9	19.1
T	1000	300	200	020	090	50C	2	640	200	197	-3	30	10.9	19.1
T	1000	300	200	020	000	50C	2	420	130	287	157	10	10.9	-.9
T	1000	300	200	020	270	50C	1	200	060	017	-43	35	10.9	24.1
T	1000	300	200	020	180	50C	2	330	105	107	2	30	10.9	19.1
T	1000	300	200	080	090	M14	2	800	240	197	-43	35	10.9	24.1
T	1000	300	200	080	000	M14	3	920	280	287	7	10	10.9	-.9
T	1000	300	200	080	270	M14	2	1240	020	017	-3	30	10.9	19.1
T	1000	300	200	080	180	M14	3	330	105	107	2	30	10.9	19.1
T	1000	300	200	080	090	50C	1	800	240	197	-43	30	10.9	19.1
T	1000	300	200	080	000	50C	3	920	280	287	7	10	10.9	-.9
T	1000	300	200	080	270	50C	2	1240	020	017	-3	30	10.9	19.1
T	1000	300	200	080	180	50C	2	340	110	107	-3	40	10.9	29.1
T	1200	300	50	020	090	M14	1	800	240	194	-46	30	2.4	27.6
T	1200	300	50	020	000	M14	1	1100	330	284	-46	20	2.4	17.6
T	1200	300	50	020	270	M14	1	230	075	014	-51	0	2.4	-2.4
T	1200	300	50	020	180	M14	1	500	150	104	-46	30	2.4	27.6
T	1200	300	50	020	090	50C	1	800	240	194	-46	30	2.4	27.6
T	1200	300	50	020	000	50C	1	1100	330	284	-46	20	2.4	17.6
T	1200	300	50	020	270	50C	1	220	070	014	-56	10	2.4	7.6
T	1200	300	50	020	180	50C	1	500	150	104	-46	30	2.4	27.6
T	1200	300	50	080	090	M14	1	800	240	194	-46	10	2.4	7.6
T	1200	300	50	080	000	M14	1	1050	325	284	-41	35	2.4	32.6
T	1200	300	50	080	270	M14	1	220	070	014	-56	20	2.4	17.6
T	1200	300	50	080	180	M14	1	340	110	104	-6	45	2.4	42.6
T	1200	300	50	080	090	50C	1	800	240	194	-46	20	2.4	17.6

T	1200	300	50	080	000	50C	1	1100	330	284	-46	30	2.4	27.6
T	1200	300	50	080	270	50C	1	220	070	014	-56	20	2.4	17.6
T	1200	300	50	080	180	50C	1	500	150	104	-46	10	2.4	7.6
T	1200	300	200	020	090	M14	3	1230	015	194	179	30	9.5	20.5
T	1200	300	200	020	000	M14	2	915	277	284	7	10	9.5	.5
T	1200	300	200	020	270	M14	2	1250	025	014	-11	30	9.5	20.5
T	1200	300	200	020	180	M14	2	340	110	104	-6	30	9.5	20.5
T	1200	300	200	020	090	50C	1	800	240	194	-46	35	9.5	25.5
T	1200	300	200	020	000	50C	2	920	280	284	4	10	9.5	.5
T	1200	300	200	020	270	50C	3	1250	025	014	-11	30	9.5	20.5
T	1200	300	200	020	180	50C	2	340	110	104	-6	30	9.5	20.5
T	1200	300	200	080	090	M14	1	800	240	194	-46	30	9.5	20.5
T	1200	300	200	080	000	M14	1	1030	315	284	-31	45	9.5	35.5
T	1200	300	200	080	270	M14	2	1230	015	014	-1	30	9.5	20.5
T	1200	300	200	080	180	M14	2	800	240	104	-136	35	9.5	25.5
T	1200	300	200	080	090	50C	1	800	240	194	-46	30	9.5	20.5
T	1200	300	200	080	000	50C	3	900	270	284	14	0	9.5	-9.5
T	1200	300	200	080	270	50C	2	1245	022	014	-8	35	9.5	25.5
T	1200	300	200	080	180	50C	1	510	155	104	-51	30	9.5	20.5

ACCEPTANCE TEST DATA

A	500	300	50	20	90	M14	1	830	255	211	44	30	4.9	25.1
A	500	300	50	20	180	M14	2	955	297	301	-4	0	4.9	-4.9
A	500	300	50	20	270	M14	2	100	030	031	-1	20	4.9	15.1
A	500	300	50	20	0	M14	1	445	147	121	26	30	4.9	25.1
A	500	300	50	20	90	50C	1	800	240	211	29	30	4.9	25.1
A	500	300	50	20	180	50C	1	1100	330	301	29	30	4.9	25.1
A	500	300	50	20	270	50C	2	1240	020	031	-11	20	4.9	15.1
A	500	300	50	20	0	50C	2	400	120	121	-1	30	4.9	25.1
A	500	300	50	80	90	M14	1	800	240	211	29	35	4.9	30.1
A	500	300	50	80	180	M14	2	945	292	301	-9	30	4.9	25.1
A	500	300	50	80	270	M14	2	100	030	031	-1	30	4.9	25.1
A	500	300	50	80	0	M14	0			121			4.9	.
A	500	300	50	80	90	50C	1	815	247	211	36	30	4.9	25.1
/	500	300	50	80	180	50C	2	945	292	301	-9	20	4.9	15.1
A	500	300	50	80	270	50C	1	215	067	031	36	30	4.9	25.1
A	500	300	50	80	0	50C	2	400	120	121	-1	20	4.9	15.1
A	500	300	200	20	90	M14	2	715	217	211	6	30	19.0	11.
A	500	300	200	20	180	M14	2	945	292	301	-9	30	19.0	11.
A	500	300	200	20	270	M14	2	100	030	031	-1	35	19.0	16.
A	500	300	200	20	0	M14	0			121			19.0	.
A	500	300	200	20	90	50C	2	645	202	211	-9	30	19.0	11.
A	500	300	200	20	180	50C	2	950	295	301	-6	30	19.0	11.
A	500	300	200	20	270	50C	3	100	030	031	-1	35	19.0	16.
A	500	300	200	20	0	50C	1	400	120	121	-1	35	19.0	16.
A	500	300	200	80	90	M14	2	700	210	211	-1	25	19.0	6.
A	500	300	200	80	180	M14	2	915	277	301	-24	30	19.0	11.
A	500	300	200	80	270	M14	3	100	030	031	-1	40	19.0	21.
A	500	300	200	80	0	M14	1	415	127	121	6	30	19.0	11.
A	500	300	200	80	90	50C	2	705	212	211	-1	20	19.0	1.
A	500	300	200	80	180	50C	2	930	300	301	-1	30	19.0	11.
A	500	300	200	80	270	50C	2	100	030	031	-1	50	19.0	31.
A	500	300	200	80	0	50C	2	430	135	121	14	30	19.0	11.
A	1000	300	50	20	90	M14	1	830	255	197	58	30	2.7	27.3
A	1000	300	50	20	0	M14	1	1100	330	287	43	30	2.7	27.3
A	1000	300	50	20	270	M14	2	1245	022	017	5	45	2.7	42.3
A	1000	300	50	20	180	M14	0			107			2.7	.
A	1000	300	50	20	90	50C	1	815	247	197	50	30	2.7	27.3
A	1000	300	50	20	0	50C	1	1055	327	287	40	20	2.7	17.3
A	1000	300	50	20	270	50C	1	205	62	017	45	0	2.7	-2.7
A	1000	300	50	20	180	50C	1	600	180	107	73	40	2.7	37.3
A	1000	300	50	80	90	M14	1	815	247	197	50	30	2.7	27.3
A	1000	300	50	80	0	M14	2	915	277	287	-10	15	2.7	12.3
A	1000	300	50	80	270	M14	2	1215	007	017	-10	30	2.7	27.3
A	1000	300	50	80	180	M14	0			107			2.7	.
A	1000	300	50	80	90	50C	1	805	242	197	45	30	2.7	27.3
A	1000	300	50	80	0	50C	2	915	277	287	-10	15	2.7	12.3
A	1000	300	50	80	270	50C	2	1230	015	017	-2	30	2.7	27.3
A	1000	300	50	80	180	50C	1	540	170	107	63	20	2.7	17.3
A	1000	300	200	20	90	M14	1	800	240	197	43	35	10.9	24.1
A	1000	300	200	20	0	M14	2	915	277	287	-10	15	10.9	4.1
A	1000	300	200	20	270	M14	1	210	065	017	48	30	10.9	19.1
A	1000	300	200	20	180	M14	1	745	232	107	125	30	10.9	19.1
/	1000	300	200	20	90	50C	1	800	240	197	43	40	10.9	29.1
A	1000	300	200	20	0	50C	3	930	285	287	-2	15	10.9	4.1
A	1000	300	200	20	270	50C	3	1230	015	017	-2	30	10.9	19.1
A	1000	300	200	20	180	50C	2	345	112	107	5	30	10.9	19.1
A	1000	300	200	80	90	M14	1	800	240	197	43	30	10.9	19.1
A	1000	300	200	80	0	M14	2	915	277	287	-10	15	10.9	4.1
A	1000	300	200	80	270	M14	3	1230	015	017	-2	40	10.9	29.1
A	1000	300	200	80	180	M14	2	345	112	107	5	30	10.9	19.1

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A	1000	300	200	80	90	50C	1	750	235	197	38	40	10.9	29.1
A	1000	300	200	80	0	50C	3	910	275	287	-12	15	10.9	4.1
A	1000	300	200	80	270	50C	3	1230	015	017	-2	40	10.9	29.1
A	1000	300	200	80	180	50C	2	345	112	107	5	30	10.9	19.1
A	1200	200	50	20	90	M14	1	800	240	190	50	35	2.4	32.6
A	1200	200	50	20	0	M14	1	1100	330	280	50	25	2.4	22.6
A	1200	200	50	20	270	M14	1	200	060	010	50	15	2.4	12.6
A	1200	200	50	20	180	M14	0			100			2.4	.
A	1200	200	50	20	90	50C	2	800	240	190	50	30	2.4	27.6
A	1200	200	50	20	0	50C	1	1115	337	280	57	30	2.4	27.6
A	1200	200	50	20	270	50C	2	1215	007	010	-3	45	2.4	42.6
A	1200	200	50	20	180	50C	1	845	262	100	162	45	2.4	42.6
A	1200	200	50	80	90	M14	1	800	240	190	50	30	2.4	27.6
A	1200	200	50	80	0	M14	2	915	277	280	-3	15	2.4	12.6
A	1200	200	50	80	270	M14	2	1200	000	010	-10	25	2.4	22.6
A	1200	200	50	80	180	M14	1	500	150	100	50	20	2.4	17.6
A	1200	200	50	80	90	50C	1	800	240	190	50	30	2.4	27.6
A	1200	200	50	80	0	50C	2	915	277	280	-3	15	2.4	12.6
A	1200	200	50	80	270	50C	1	215	067	010	57	30	2.4	27.6
A	1200	200	50	80	180	50C	1	500	150	100	50	20	2.4	17.6
A	1200	200	200	20	90	M14	1	745	232	190	42	40	9.4	30.6
A	1200	200	200	20	0	M14	2	1030	315	280	35	45	9.4	35.6
A	1200	200	200	20	270	M14	2	1230	015	010	5	30	9.4	20.6
A	1200	200	200	20	180	M14	1	445	144	100	44	30	9.4	20.6
A	1200	200	200	20	90	50C	2	800	240	190	50	35	9.4	25.6
/	1200	200	200	20	0	50C	2	915	277	280	-3	15	9.4	5.6
A	1200	200	200	20	270	50C	2	1230	015	010	5	30	9.4	20.6
A	1200	200	200	20	180	50C	2	330	105	100	5	30	9.4	20.6
A	1200	200	200	80	90	M14	1	745	232	190	42	30	9.4	20.6
A	1200	200	200	80	0	M14	4			280		20	9.4	10.6
A	1200	200	200	80	270	M14	2	1230	015	010	5	40	9.4	30.6
A	1200	200	200	80	180	M14	1	445	142	100	42	15	9.4	5.6
A	1200	200	200	80	90	50C	1	800	240	190	50	30	9.4	20.6
A	1200	200	200	80	0	50C	1	1100	330	280	50		9.4	.
A	1200	200	200	80	270	50C	2	1245	022	010	12	30	9.4	20.6
A	1200	200	200	80	180	50C	2	345	112	100	12	30	9.4	20.6
B	500	300	50	20	90	M14	1	800	240	211	29	60	4.9	55.1
B	500	300	50	20	0	M14	1	500	150	301	-151	35	4.9	30.1
B	500	300	50	20	270	M14	2	1000	300	031	91	15	4.9	10.1
B	500	300	50	20	180	M14	2	1100	330	121	151	15	4.9	10.1
B	500	300	50	20	90	50	1	800	240	211	29	35	4.9	30.1
B	500	300	50	20	0	50	2	1000	300	301	-1	15	4.9	10.1
B	500	300	50	20	270	50	2	100	030	031	-1	30	4.9	25.1
B	500	300	50	20	180	50	2	430	135	121	14	35	4.9	30.1
B	500	300	50	80	90	M14	1	800	240	211	29	30	4.9	25.1
B	500	300	50	80	0	M14	1	1100	330	301	29	40	4.9	35.1
B	500	300	50	80	270	M14	2	100	030	031	-1	35	4.9	30.1
B	500	300	50	80	180	M14	1	445	142	121	21		4.9	.
B	500	300	50	80	90	50	2	715	217	211	6	30	4.9	25.1
B	500	300	50	80	0	50	2	930	285	301	-16	30	4.9	25.1
B	500	300	50	80	270	50	2	100	030	031	-1	40	4.9	35.1
B	500	300	50	80	180	50	2	400	120	121	-1	30	4.9	25.1
B	500	300	200	20	90	M14	3	700	210	211	-1	30	19.0	11.
B	500	300	200	20	0	M14	4	945	292	301	-9	30	19.0	11.
B	500	300	200	20	270	M14	2	1230	015	031	-16	30	19.0	11.
B	500	300	200	20	180	M14	2	500	150	121	29	30	19.0	11.
B	500	300	200	20	90	50	3	700	210	211	-1	30	19.0	11.
B	500	300	200	20	0	50	2	955	297	301	-4	30	19.0	11.
B	500	300	200	20	270	50	2	100	030	031	-1	35	19.0	16.
B	500	300	200	20	180	50	1	515	157	121	36	30	19.0	11.

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B	500	300	200	80	90	M14	2	815	247	211	36	30	19.0	11.
B	500	300	200	80	0	M14	2	745	232	301	-69	30	19.0	11.
B	500	300	200	80	270	M14	2	115	037	031	6	45	19.0	26.
B	500	300	200	80	180	M14	2	415	127	121	6	30	19.0	11.
B	500	300	200	80	90	50	2	715	217	211	6	30	19.0	11.
B	500	300	200	80	0	50	3	930	285	301	-16	30	19.0	11.
B	500	300	200	80	270	50	1	100	030	031	-1	45	19.0	26.
B	500	300	200	80	180	50	2	400	120	121	-1	15	19.0	-4.
B	1000	300	50	20	90	M14	1	815	247	197	50	35	2.7	32.3
B	1000	300	50	20	0	M14	1	1100	330	287	43	30	2.7	27.3
B	1000	300	50	20	270	M14	1	200	060	017	43	30	2.7	27.3
B	1000	300	50	20	180	M14	0			107			2.7	.
B	1000	300	50	20	90	50C	1	830	255	197	58	30	2.7	27.3
B	1000	300	50	20	0	50C	3	930	285	287	-2	15	2.7	12.3
B	1000	300	50	20	270	50C	2	1245	022	017	5	30	2.7	27.3
B	1000	300	50	20	180	50C	2	330	105	107	-2	30	2.7	27.3
B	1000	300	50	80	90	M14	1	800	240	197	43	30	2.7	27.3
B	1000	300	50	80	0	M14	1	1100	330	287	43	45	2.7	42.3
B	1000	300	50	80	270	M14	3	1230	015	017	-2	30	2.7	27.3
B	1000	300	50	80	180	M14	0			107			2.7	.
B	1000	300	50	80	90	50C	1	815	247	197	50	30	2.7	27.3
B	1000	300	50	80	0	50C	3	915	277	287	-10	15	2.7	12.3
B	1000	300	50	80	270	50C	1	200	060	017	43	35	2.7	32.3
B	1000	300	50	80	180	50C	1	515	157	107	50	15	2.7	12.3
B	1000	300	200	20	90	M14	2	900	270	197	73	45	10.9	34.1
B	1000	300	200	20	0	M14	3	915	277	287	-10	15	10.9	4.1
B	1000	300	200	20	270	M14	1	215	067	017	50	30	10.9	19.1
B	1000	300	200	20	180	M14	1	445	144	107	37	35	10.9	24.1
B	1000	300	200	20	90	50C	2	815	247	197	50	35	10.9	24.1
B	1000	300	200	20	0	50C	3	915	277	287	-10	20	10.9	9.1
B	1000	300	200	20	270	50C	3	1245	022	017	5	30	10.9	19.1
B	1000	300	200	20	180	50C	2	400	120	107	13	35	10.9	24.1
B	1000	300	200	80	90	M14	1	815	247	197	50	30	10.9	19.1
B	1000	300	200	80	0	M14	1	1100	330	287	43		10.9	.
B	1000	300	200	80	270	M14	1	200	060	017	43	30	10.9	19.1
B	1000	300	200	80	180	M14	0			107			10.9	.
B	1000	300	200	80	90	50C	1	815	247	197	50	45	10.9	34.1
B	1000	300	200	80	0	50C	2	915	277	287	-10	15	10.9	4.1
B	1000	300	200	80	270	50C	1	215	067	017	50	35	10.9	24.1
B	1000	300	200	80	180	50C	2	400	120	107	13	30	10.9	19.1
B	1200	200	50	20	90	M14				190			2.4	
B	1200	200	50	20	0	M14				280			2.4	
B	1200	200	50	20	270	M14				010			2.4	
B	1200	200	50	20	180	M14				100			2.4	
B	1200	200	50	20	90	50C				190			2.4	
B	1200	200	50	20	0	50C				280			2.4	
B	1200	200	50	20	270	50C				010			2.4	
B	1200	200	50	20	180	50C				100			2.4	
B	1200	200	50	80	90	M14	1	815	247	190	57	30	2.4	27.6
B	1200	200	50	80	0	M14	2	430	135	280	-145	30	2.4	27.6
B	1200	200	50	80	270	M14	2			010		30	2.4	27.6
B	1200	200	50	80	180	M14	0			100			2.4	.
B	1200	200	50	80	90	50C				190			2.4	.
B	1200	200	50	80	0	50C				280			2.4	.
B	1200	200	50	80	270	50C				010			2.4	.
B	1200	200	50	80	180	50C				100			2.4	.
B	1200	200	200	20	90	M14	1	830	255	190	65	30	9.4	20.6
B	1200	200	200	20	0	M14	2	1015	307	280	27	45	9.4	35.6
B	1200	200	200	20	270	M14	1	145	082	010	72	30	9.4	20.6
B	1200	200	200	20	180	M14	2	330	105	100	5	40	9.4	30.6

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B	1200	200	200	20	90	50C	2	800	240	190	50	35	9.4	25.6
B	1200	200	200	20	0	50C	1	1045	322	280	42	40	9.4	30.6
B	1200	200	200	20	270	50C	1	200	060	010	50	35	9.4	25.6
B	1200	200	200	20	180	50C	3	315	097	100	-3	40	9.4	30.6
B	1200	200	200	80	90	M14	1	815	247	190	57	30	9.4	20.6
B	1200	200	200	80	0	M14	2	1045	322	280	42	45	9.4	35.6
B	1200	200	200	80	270	M14	2	200	060	010	50	30	9.4	20.6
B	1200	200	200	80	180	M14	1	445	142	100	42	20	9.4	10.6
B	1200	200	200	80	90	50C	1	815	247	190	57	30	9.4	20.6
B	1200	200	200	80	0	50C	4	915	277	280	-3	20	9.4	10.6
B	1200	200	200	80	270	50C	2	200	060	010	50	45	9.4	35.6
B	1200	200	200	80	180	50C	1	445	142	100	42	20	9.4	10.6
C	500	300	50	20	90	M14	0			211			4.9	
C	500	300	50	20	0	M14	2	945	292	301	-9	15	4.9	10.1
C	500	300	50	20	270	M14	2	100	030	031	-1	30	4.9	25.1
C	500	300	50	20	180	M14	1	515	157	121	36	45	4.9	40.1
C	500	300	50	20	90	50C	2	730	225	211	14	30	4.9	25.1
C	500	300	50	20	0	50C	2	945	292	301	-9	0	4.9	-4.9
C	500	300	50	20	270	50C	2	105	032	031	1	30	4.9	25.1
C	500	300	50	20	180	50C	1	415	127	121	6	40	4.9	35.1
C	500	300	50	80	90	M14	2	600	180	211	-31	50	4.9	45.1
C	500	300	50	80	0	M14	2	945	292	301	-9	20	4.9	15.1
C	500	300	50	80	270	M14	2	100	030	031	-1	40	4.9	35.1
C	500	300	50	80	180	M14	0			121			4.9	•
C	500	300	50	80	90	50C	1	800	240	211	9	30	4.9	25.1
C	500	300	50	80	0	50C	2	945	292	301	-9	25	4.9	20.1
C	500	300	50	80	270	50C	2	1100	330	031	-61	90	4.9	85.1
C	500	300	50	80	180	50C	0			121			4.9	•
C	500	300	200	20	90	M14	2	300	090	211	-121	35	19.0	16.
C	500	300	200	20	0	M14	3	945	292	301	-9	30	19.0	11.
C	500	300	200	20	270	M14	3	100	030	031	-1	30	19.0	11.
C	500	300	200	20	180	M14	0			121			19.0	•
C	500	300	200	20	90	50C	2	645	202	211	-9	30	19.0	11.
C	500	300	200	20	0	50C	2	945	292	301	-9	30	19.0	11.
C	500	300	200	20	270	50C	2	130	045	031	14	40	19.0	21.
C	500	300	200	20	180	50C	2	430	135	121	14	40	19.0	21.
C	500	300	200	80	90	M14	1	800	240	211	29	30	19.0	11.
C	500	300	200	80	0	M14	2	930	285	301	-16	30	19.0	11.
C	500	300	200	80	270	M14	3	105	032	031	1	45	19.0	26.
C	500	300	200	80	180	M14	2	400	120	121	-1	30	19.0	11.
C	500	300	200	80	90	50C	2	645	202	211	-9	20	19.0	1.
C	500	300	200	80	0	50C	2	920	280	301	-21	30	19.0	11.
C	500	300	200	80	270	50C	2	1250	025	031	-6	40	19.0	21.
C	500	300	200	80	180	50C	2	415	127	121	6	30	19.0	11.
C	1000	300	50	20	90	M14	0			197			2.7	
C	1000	300	50	20	0	M14	1	1045	322	287	35	30	2.7	27.3
C	1000	300	50	20	270	M14	1	200	060	017	43	30	2.7	27.3
C	1000	300	50	20	180	M14	0			107			2.7	
C	1000	300	50	20	90	50C	1	815	247	197	50	30	2.7	27.3
C	1000	300	50	20	0	50C	2	915	277	287	-10	0	2.7	-2.7
C	1000	300	50	20	270	50C	2	1230	015	017	-2	30	2.7	27.3
C	1000	300	50	20	180	50C	0			107			2.7	•
C	1000	300	50	80	90	M14	1	800	240	197	43	30	2.7	27.3
C	1000	300	50	80	0	M14	1	1100	330	287	43	40	2.7	37.3
C	1000	300	50	80	270	M14	1	205	062	017	45	30	2.7	27.3
C	1000	300	50	80	180	M14	0			107			2.7	•
C	1000	300	50	80	90	50C	0			197			2.7	•
C	1000	300	50	80	0	50C	1	1050	325	287	38	40	2.7	37.3
C	1000	300	50	80	270	50C	2	1215	007	017	-10	40	2.7	37.3
C	1000	300	50	80	180	50C	0			107			2.7	•

C	1000	300	200	20	90	M14	1	830	255	197	58	30	10.9	19.1
C	1000	300	200	20	0	M14	3	900	270	287	-17	50	10.9	39.1
C	1000	300	200	20	270	M14	1	150	055	017	38	30	10.9	19.1
C	1000	300	200	20	180	M14	2	500	150	107	43	25	10.9	14.1
C	1000	300	200	20	90	50C	4	630	195	197	-2	30	10.9	19.1
C	1000	300	200	20	0	50C	2	940	290	287	3	20	10.9	19.1
C	1000	300	200	20	270	50C	2	140	050	017	33	30	10.9	19.1
C	1000	300	200	20	180	50C	1	530	165	107	52	30	10.9	19.1
C	1000	300	200	80	90	M14	0			197			10.9	.
C	1000	300	200	80	0	M14	1	130	045	287	-118	45	10.9	34.1
C	1000	300	200	80	270	M14	3	1215	007	017	-10	45	10.9	34.1
C	1000	300	200	80	180	M14	1	500	150	107	43	20	10.9	9.1
C	1000	300	200	80	90	50C	1	745	232	197	35	35	10.9	24.1
C	1000	300	200	80	0	50C	2	915	277	287	-10	20	10.9	9.1
C	1000	300	200	80	270	50C	2	1210	005	017	-12	45	10.9	34.1
C	1000	300	200	80	180	50C	1	500	150	107	43	30	10.9	19.1
C	1200	200	50	20	90	M14	1	745	232	190	42	30	2.4	27.6
C	1200	200	50	20	0	M14	1	1100	330	280	50	30	2.4	27.6
C	1200	200	50	20	270	M14	1	145	052	010	42	30	2.4	27.6
C	1200	200	50	20	180	M14	0			100			2.4	.
C	1200	200	50	20	90	50C	1	830	255	190	65	75	2.4	72.6
C	1200	200	50	20	0	50C	1	1100	330	280	50	30	2.4	27.6
C	1200	200	50	20	270	50C	1	145	052	010	42	30	2.4	27.6
C	1200	200	50	20	180	50C	0			100			2.4	.
C	1200	200	50	80	90	M14	1	800	240	190	50	30	2.4	27.6
C	1200	200	50	80	0	M14	1	1045	322	280	52	35	2.4	32.6
C	1200	200	50	80	270	M14	1	150	050	010	40	30	2.4	27.6
C	1200	200	50	80	180	M14	0			100			2.4	.
C	1200	200	50	80	90	50C	1	815	247	190	57	30	2.4	27.6
C	1200	200	50	80	0	50C	2	905	272	280	-8	20	2.4	17.6
C	1200	200	50	80	270	50C	1	210	065	010	55	35	2.4	32.6
C	1200	200	50	80	180	50C	1	450	145	100	45	20	2.4	17.6
C	1200	200	200	20	90	M14	1	750	235	190	45	35	9.4	25.6
C	1200	200	200	20	0	M14	2	345	112	280	-168	30	9.4	20.6
C	1200	200	200	20	270	M14	2	200	060	010	50	30	9.4	20.6
C	1200	200	200	20	180	M14	0			100			9.4	.
C	1200	200	200	20	90	50C	3	630	195	190	5	30	9.4	20.6
C	1200	200	200	20	0	50C	2	1100	330	280	50	45	9.4	35.6
C	1200	200	200	20	270	50C	2	1245	022	010	12	60	9.4	50.6
C	1200	200	200	20	180	50C	1	500	150	100	50	35	9.4	25.6
C	1200	200	200	80	90	M14	0			190			9.4	.
C	1200	200	200	80	0	M14	1	1030	315	280	35	50	9.4	40.6
C	1200	200	200	80	270	M14	1	200	060	010	50	45	9.4	35.6
C	1200	200	200	80	180	M14	0			100			9.4	.
C	1200	200	200	80	90	50C	1	800	240	190	50	30	9.4	20.6
C	1200	200	200	80	0	50C	2	1045	322	280	42	50	9.4	45.6
C	1200	200	200	80	270	50C	1	200	060	010	50	45	9.4	35.6
C	1200	200	200	80	180	50C	2	345	112	100	12	40	9.4	30.6
C	1500	80	200	80	90	M14	0						9.4	
C	1500	80	200	80	0	M14	1	1200	000				9.4	
C	1500	80	200	80	270	M14	1	300	090			45	9.4	35.6
C	1500	80	200	80	180	M14	1	530	165			35	9.4	25.6
D	500	300	50	20	90	M14	1	830	255	211	44	30	4.9	25.1
D	500	300	50	20	0	M14	2	945	292	301	-9	15	4.9	10.1
D	500	300	50	20	270	M14	1	215	067	031	31	25	4.9	20.1
D	500	300	50	20	180	M14	0			121			4.9	.
D	500	300	50	20	90	50	2	715	217	211	6	30	4.9	25.1
D	500	300	50	20	0	50	2	945	292	301	-9	20	4.9	15.1
D	500	300	50	20	270	50	2	100	030	031	-1	25	4.9	20.1
D	500	300	50	20	180	50	0			121			4.9	.

D	500	300	50	80	90	M14	1	815	247	211	36	30	4.9	25.1
D	500	300	50	80	0	M14	2			301		20	4.9	15.1
D	500	300	50	80	270	M14	2	1245	022	031	-9	35	4.9	30.1
D	500	300	50	80	180	M14	1	415	127	121	6	30	4.9	25.1
D	500	300	50	80	90	50C	2	715	217	211	6	15	4.9	10.1
D	500	300	50	80	0	50C	2	930	285	301	-16	30	4.9	25.1
D	500	300	50	80	270	50C	2	1100	330	031	-61	35	4.9	30.1
D	500	300	50	80	180	50C	2	430	135	121	14	15	4.9	10.1
D	500	300	200	20	90	M14	1	815	247	211	36	40	19.0	21.
D	500	300	200	20	0	M14	3	945	292	301	-9	35	19.0	16.
D	500	300	200	20	270	M14	3	1240	020	031	-11	30	19.0	11.
D	500	300	200	20	180	M14	1	400	120	121	-1	35	19.0	16.
D	500	300	200	20	90	50C	3	645	202	211	-9	30	19.0	11.
D	500	300	200	20	0	50C	2	945	292	301	-9	30	19.0	11.
D	500	300	200	20	270	50C	2	115	037	031	6	35	19.0	16.
D	500	300	200	20	180	50C	3	400	120	121	-1	30	19.0	11.
D	500	300	200	80	90	M14	2	700	210	211	-1	20	19.0	1.
D	500	300	200	80	0	M14	3	945	292	301	-9	30	19.0	11.
D	500	300	200	80	270	M14	2	100	030	031	-1	35	19.0	16.
D	500	300	200	80	180	M14	2	415	127	121	6	30	19.0	11.
D	500	300	200	80	90	50C	2	700	210	211	-1	15	19.0	-4.
D	500	300	200	80	0	50C	2	945	292	301	9	35	19.0	16.
D	500	300	200	80	270	50C	2	100	030	031	-1	40	19.0	21.
D	500	300	200	80	180	50C	2	430	135	121	14	30	19.0	11.
D	1000	300	50	20	90	M14	1	750	230	197	33	35	2.7	32.3
D	1000	300	50	20	0	M14	1	1100	330	287	43	30	2.7	27.3
D	1000	300	50	20	270	M14	3	1230	015	017	-2	30	2.7	27.3
D	1000	300	50	20	180	M14	1	645	202	107	95	50	2.7	47.3
D	1000	300	50	20	90	50C	1	800	240	197	43	35	2.7	32.3
D	1000	300	50	20	0	50C	2	630	195	287	-92	75	2.7	72.3
D	1000	300	50	20	270	50C	1	215	067	017	50	20	2.7	17.3
D	1000	300	50	20	180	50C	2	530	165	107	52	30	2.7	27.3
D	1000	300	50	80	90	M14	1	800	240	197	43	30	2.7	27.3
D	1000	300	50	80	0	M14	2	915	277	287	-10	20	2.7	17.3
D	1000	300	50	80	270	M14	1	200	060	017	43	30	2.7	27.3
D	1000	300	50	80	180	M14	1	500	150	107	43	20	2.7	17.3
D	1000	300	50	80	90	50C	1	800	240	197	43	30	2.7	27.3
D	1000	300	50	80	0	50C	2	900	270	287	-17	20	2.7	17.3
D	1000	300	50	80	270	50C	2	1215	007	017	-10	35	2.7	32.3
D	1000	300	50	80	180	50C	2	330	105	107	-2	30	2.7	27.3
D	1000	300	200	20	90	M14	1	800	240	197	43	30	10.9	19.1
D	1000	300	200	20	0	M14	3	905	272	287	-15	25	10.9	14.1
D	1000	300	200	20	270	M14	2	1215	007	017	-10	30	10.9	19.1
D	1000	300	200	20	180	M14	0			107			10.9	.
D	1000	300	200	20	90	50C	2	745	232	197	35	45	10.9	34.1
D	1000	300	200	20	0	50C	2	915	277	287	-10	20	10.9	9.1
D	1000	300	200	20	270	50C	2	1215	007	017	-10	30	10.9	19.1
D	1000	300	200	20	180	50C	1	515	157	107	50	30	10.9	19.1
D	1000	300	200	80	90	M14	1	815	247	197	50	35	10.9	24.1
D	1000	300	200	80	0	M14	2	1000	300	287	13	60	10.9	49.1
D	1000	300	200	80	270	M14	3	1130	345	017	-32	0	10.9	-10.9
D	1000	300	200	80	180	M14	0			107			10.9	.
D	1000	300	200	80	90	50C	2	630	195	197	-2	0	10.9	-10.9
D	1000	300	200	80	0	50C	2	915	277	287	-10	30	10.9	19.1
D	1000	300	200	80	270	50C	1	200	060	017	43	40	10.9	29.1
D	1000	300	200	80	180	50C	3	345	112	107	5	30	10.9	19.1
D	1200	200	50	20	90	M14	1	815	247	190	57	35	2.4	32.6
D	1200	200	50	20	0	M14	1	915	277	280	-3	15	2.4	12.6
D	1200	200	50	20	270	M14	1	200	060	010	50	15	2.4	12.6
D	1200	200	50	20	180	M14	0			100			2.4	.

D	1200	200	50	20	90	50C	1	800	240	190	50	35	2.4	32.6
D	1200	200	50	20	0	50C	1	1100	330	280	50	30	2.4	27.6
D	1200	200	50	20	270	50C	1	210	065	010	55	25	2.4	22.6
D	1200	200	50	20	180	50C	1	500	150	100	50	35	2.4	32.6
D	1200	200	50	80	90	M14	1	800	240	190	50	30	2.4	27.6
D	1200	200	50	80	0	M14	1	1045	322	280	42	40	2.4	37.6
D	1200	200	50	80	270	M14	2	1230	015	010	5	45	2.4	42.6
D	1200	200	50	80	180	M14	0			100			2.4	.
D	1200	200	50	80	90	50C	2	800	240	190	50	30	2.4	27.6
D	1200	200	50	80	0	50C	1	1000	300	280	20	40	2.4	37.6
D	1200	200	50	80	270	50C	1	200	060	010	50	30	2.4	27.6
D	1200	200	50	80	180	50C	0			100			2.4	.
D	1200	200	200	20	90	M14	1	800	240	190	50	35	9.4	25.6
D	1200	200	200	20	0	M14	4	900	270	280	-10	15	9.4	5.6
D	1200	200	200	20	270	M14	2	100	030	010	20	0	9.4	-9.4
D	1200	200	200	20	180	M14	3	345	112	100	12	15	9.4	5.6
D	1200	200	200	20	90	50C	1	800	240	190	50	40	9.4	30.6
D	1200	200	200	20	0	50C	2	945	292	280	18	50	9.4	40.6
D	1200	200	200	20	270	50C	4	200	060	010	50	30	9.4	20.6
D	1200	200	200	20	180	50C	1	445	142	100	42	30	9.4	20.6
D	1200	200	200	80	90	M14	2	400	120	190	-70		9.4	.
D	1200	200	200	80	0	M14	1	945	292	280	12	45	9.4	35.6
D	1200	200	200	80	270	M14	1	200	060	010	50	30	9.4	20.6
D	1200	200	200	80	180	M14	0			100			9.4	.
D	1200	200	200	80	90	50C	1	750	230	190	40	30	9.4	20.6
D	1200	200	200	80	0	50C	1	1045	322	280	42	50	9.4	40.6
D	1200	200	200	80	270	50C	2	915	277	010	-93	25	9.4	15.6
D	1200	200	200	80	180	50C	1	510	155	100	55	15	9.4	5.6

APPENDIX B

This appendix is a copy of the test plan as submitted to the Limited War Laboratory on 2 July 1968.

Test Plan: Improved Acoustic Locator System (Final Draft)
2 July 1968

I. INTRODUCTION

This test program has been designed for conduct in certain numbers of tests called "blocks". One block of tests includes 180 separate tests using all weapons at one range location. These weapons fire at the aircraft from four aspects. The aircraft will fly at 5 different altitudes and 3 different speeds. A full block of tests will require approximately $3\frac{3}{4}$ hours of work. In order to conduct tests of special conditions, portions of these test blocks will be run to obtain results of detection and location accuracy.

With this design of test blocks and portions of blocks for special tests, a good program can be expected even with unforseen circumstances presenting themselves. The total program can be reduced, changed or expanded to meet all circumstances.

This copy of the test plan supersedes the initial draft submitted to the LWL on 25 June 1968.

II. TEST EQUIPMENT

The equipment for these tests will consist primarily of existing, common and readily available items of equipment. For this discussion the equipment needed is divided into three groups as noted below.

(1) Range layout equipment

2 surveyor's transits

2-100 ft steel tapes

500 ft of engineers tape

25 wooden pegs

The range layout will consist of measuring off and marking the 18 firing points, the two a/c locator sites, and the range marker as noted in figure one. The points having been located by use of the tape and the transits, they would be marked for later use by driving the wooden stakes into the ground at each location. It would be desirable that the stakes each have written on them the point which it represents. The range marker will be located by laying white engineers tape in a cross of 100 ft legs in the direction of the 4 points of the compass N-E-S-W.

(2) Basic testing equipment (for the field)

1 UH-1B helicopter

1 UH-1D helicopter

? Improved Acoustic Locator Systems

1 22 caliber set of weapons

1 30 caliber set of weapons

1 50 caliber set of weapons

2 aircraft locator items of equipment

1 $\frac{3}{4}$ ton truck with radio (type ?)

3 hand held radios

1 field table

2 folding chairs

1500 rounds of 22 caliber ammo

1500 rounds of 30 caliber ammo

1500 rounds of 50 caliber ammo

? compass(s)

1 wind measuring device

The weapons, ammo, ILAS, and helicopters requirements are basic to the test and no further discussion of them will be presented here. The items to be used to locate the helicopter during the tests are dependent upon the accuracy desired of test results. Their purpose is to aid the observer in locating the a/c at the precise time the weapon is fired. This is to allow for development of valid azimuth and depression angle information against which the test data can be compared in order to reveal the accuracy of location of the weapon from the system being tested. The $\frac{3}{4}$ ton truck is needed for transportation of personnel and equipment to and from the range

each day. The radio in the truck and the 3 walkie talkie type radio uses are discussed in Section IV of this plan. The field table and chairs are needed to provide a reasonable condition for the recording of data in the field. The wind measuring device is needed for recording the wind speed and direction during the tests. Some type of compass is needed to aid in "surveying" the guns each day to assure they are aimed in a direction parallel and perpendicular to the a/c line of flight.

(3) Personnel

1 Test Director

1 Pilot

1 Co-pilot

3 Weapon Crew

1 Data Recorder

2 a/c Position Locators

Variations of this test crew as well as the duties of each are discussed in Section IV. In addition to these persons for test conduct, approximately 3 persons will be needed prior to the tests for the layout of the range.

III. RANGE LAYOUT

The real estate over which these tests can be conducted will require approximately 30-40 acres with a geometric pattern of approximately l = 2w. It would be desirable that the land be slightly wooded, but not so as to prevent the observation or restrict the flight path of the flying helicopters at the ranges and altitudes noted in this plan. Although the vegetation, topography, bodies of water, etc., will influence the operation of the system, it is not a factor in the factorial design of these tests. The condition of the terrain will be documented and results of the system under other conditions of terrain can only be estimated. In order to facilitate range layout and accuracy figures, it is desirable that the land be relatively flat. The layout of the range should ultimately be as shown in Figure 1. This shows basically one range marker over which the a/c will be when fired at, two marked sites where persons are positioned to help locate the a/c at the time of firing, and 18 firing points which gives all combinations of miss distance and range believed to be required for evaluation of the system.

Although 30-40 acres should allow for the space needed to establish the points required on the range, the use of live ammunition will obviously require the use of a downrange impact area. Since the weapons will all be fired in the same direction and the firing points will change only daily, during normal testing the size of a very small firing fan can be determined each day. This fan would be defined by the range of weapon being used on a given day and by the maximum deflection error of the weapon at its maximum range.

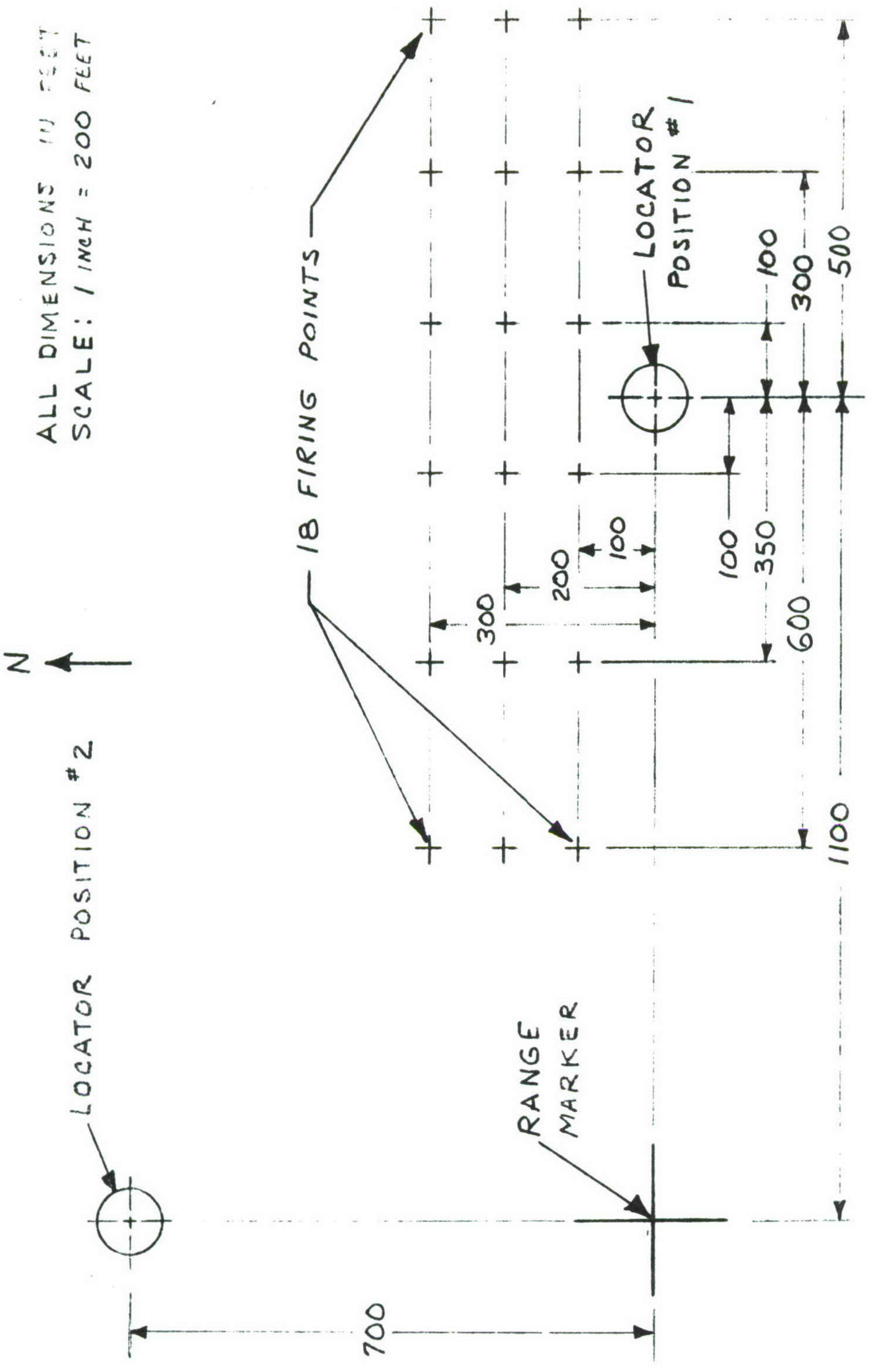

FIG. 1; RANGE LAYOUT

It is envisioned that the range layout will consist of merely marking a ground position for the locator points and for the firing points. The range marker should consist of white engineer tape positioned in the manner shown with the length of each of the four legs being 100 ft. These legs indicate the desired flight path during the tests. In the event that night testing is desired or required, the range marker would consist of battery powered lights—9 of one color in one line and 9 of another color in the other line.

IV. TEST SCHEDULE

The design of these tests is such that distinct breaks are realized at the conclusion of 4 tests, 12 tests, 36 tests, 180 tests, 540 tests and 3240 tests. These breaks are when there is a change in one of the controlled factors of the test. This is more fully discussed in Section IV, but the proposed program will be conducted in 18 blocks of tests each requiring an estimated 3-3/4 hr of the aircraft flying over the range. In addition to these 18 blocks of tests, various demonstrations as discussed later will be required during the test program. It is envisioned that a particular test day will allow for the completion of one block of tests plus about 1-2 hr for additional work if needed. Therefore, the approach has been to develop a priority listing of the blocks of tests (see Figure 2), assign them a particular test day and expect to conduct the particular demonstrations on off days or at the day's end of a particular block of tests. As is indicated in Section IV, one block of tests consists of the total activity required at one of the eighteen firing points.

Miss Distance	Range 500	750	1000	1200	1400	1600
300	J	M	B	R	E	I
200	D	G	N	L	Q	C
100	P	A	H	F	K	O

FIGURE 2. PRIORITY OF TEST BLOCKS

If a maximum of one block of tests are conducted each test day, the tests could be completed from 8 June through 31 June. Allowing for some unforseen circumstances such as range scheduling, a/c maintenance, weather, etc., the testing rate would be slowed but not excessively unless the program cannot be completed by August 16. The establishment of the priority of test blocks should allow minimum analysis problems if the test program is cancelled at any time. With this assumption, the program would terminate no earlier than June 31 with all tests completed or not later than August 16 with any portion or all of the tests completed.

To complete 1 block of tests, the aircraft would fly the prescribed course a minimum of 45 times, be fired at 180 times at combinations of three speeds and five altitudes. Each of the three sets of weapons will fire 60 times during the block of tests.

The actual tests should begin on 8 June with the previous week set aside for range layout, equipment installation and check-out and for pilot testing. Pilot testing should provide for final definition of communication procedures, firing procedures and data recording procedures.

It is felt that the weapon performance and the IALS performance will dictate the maximum range and miss distance which should be investigated during these tests. These have been defined as 1600 ft range and 300 ft miss distance. If initial testing would reveal information which indicates these two factors are <u>not</u> the reasonable maximums, the plan should be altered to obtain additional information at perhaps 1800 ft range and/or 400 ft miss distance. These changes cannot be anticipated at this time, but the test design change would merely call for assigning a priority to each of the additional factors and "fitting" them into the proposed sequence of tests. Time and resources would then again dictate the termination of the testing.

The design of the major portion of the program is such that each day's activity can be defined as a block or blocks of tests. Because of this, blocks of tests can easily be added, deleted, or changed without disrupting the overall test schedule.

V. TEST PROCEDURES

For these tests the locator site #1 (LS-1) will be the position where three persons will be operating. They are the locator man, the data recorder, and the Test Director (TD). Three-way communications would be established between the firing point (FP) and each of the locator sites. Two-way communication is needed between the aircraft and the locator site #1. The TD should be able to continually inform the pilot of the speed and altitude he is to maintain over the range marker. This information is presented in Figure 3. The co-pilot reading the scope in the aircraft must be able to transmit his interpretation of the system performance to the data recorder. The locator points should be in communication with the firing point in order to give the order for "fire" at the proper time. Communication during the tests would be somewhat like as follows:

TD to pilot	-	"Pass west at 200 ft and 40 knots"
LS-2 to FP	-	At the time the aircraft is over the firing point - "Fire"
Copilot to LS-1	-	"Audio, 3 points, azimuth 160°, deflection 20°"

Figure 3; A/C PROCEDURE FOR EACH BLOCK OF TESTS

Run Number	Altitude	Speed		Run Number	Altitude	Speed
1	15	0		24	200	40
2		0		25		80
3		0		26		80
4		40		27	200	80
5		40		28	500	0
6		40		29		0
7		80		30		0
8		80		31		40
9	15	80		32		40
10	50	0		33		40
11		0		34		80
12		0		35		80
13		40		36	500	80
14		40		37	1000	0
15		40		38		0
16		80		39		0
17		80		40		40
18	50	80		41		40
19	200	0		42		40
20		0		43		80
21		0		44		80
22		40		45	1000	80
23		40				

TD to Pilot	-	After assuring that data are recorded - "Pass north" - Pilot does a 270^{o} turn back over the range marker without changing speed or altitude
LS-1 to FP	-	At the time the aircraft is over firing point - "Fire"
Copilot to LS-1	-	"Audio, 3 points, azimuth 90^{o}, deflection 20^{o}"
TD to pilot	-	"Pass east"
LS-2 to FP	-	"Fire"
Copilot to LS-1	-	"Audio, 3 points, azimuth _____, deflection _____"
TD to pilot	-	"Pass south"
Copilot to LS-1	-	"Audio, 3 points, azimuth, deflection _____"
TD to FP	-	"Ready with Weapon 2"
FP to TD	-	"Weapon 2 ready"
TD to pilot	-	"Pass west at 200 ft and 40 knots"

etc.

Safety precautions are most critical during the pass to the north. (See Figure 4.) At this time the bullet is being fired in front of the a/c and any delay in firing could be noticed. During this pass the miss distance should be primarily in the vertical direction. This is to be accomplished by the a/c maintaining 15 ft additional altitude than on other passes during the same run.

Any of the special tests, i.e., loaded helicopter, UH-1D instead of UH-1B, etc., would be run in a similar manner. Weapon sequence and elevation angles to be set when firing for each run at a particular range is as noted in Figure 5. Samples of the two basic data forms appear on pp. 15 and 16.

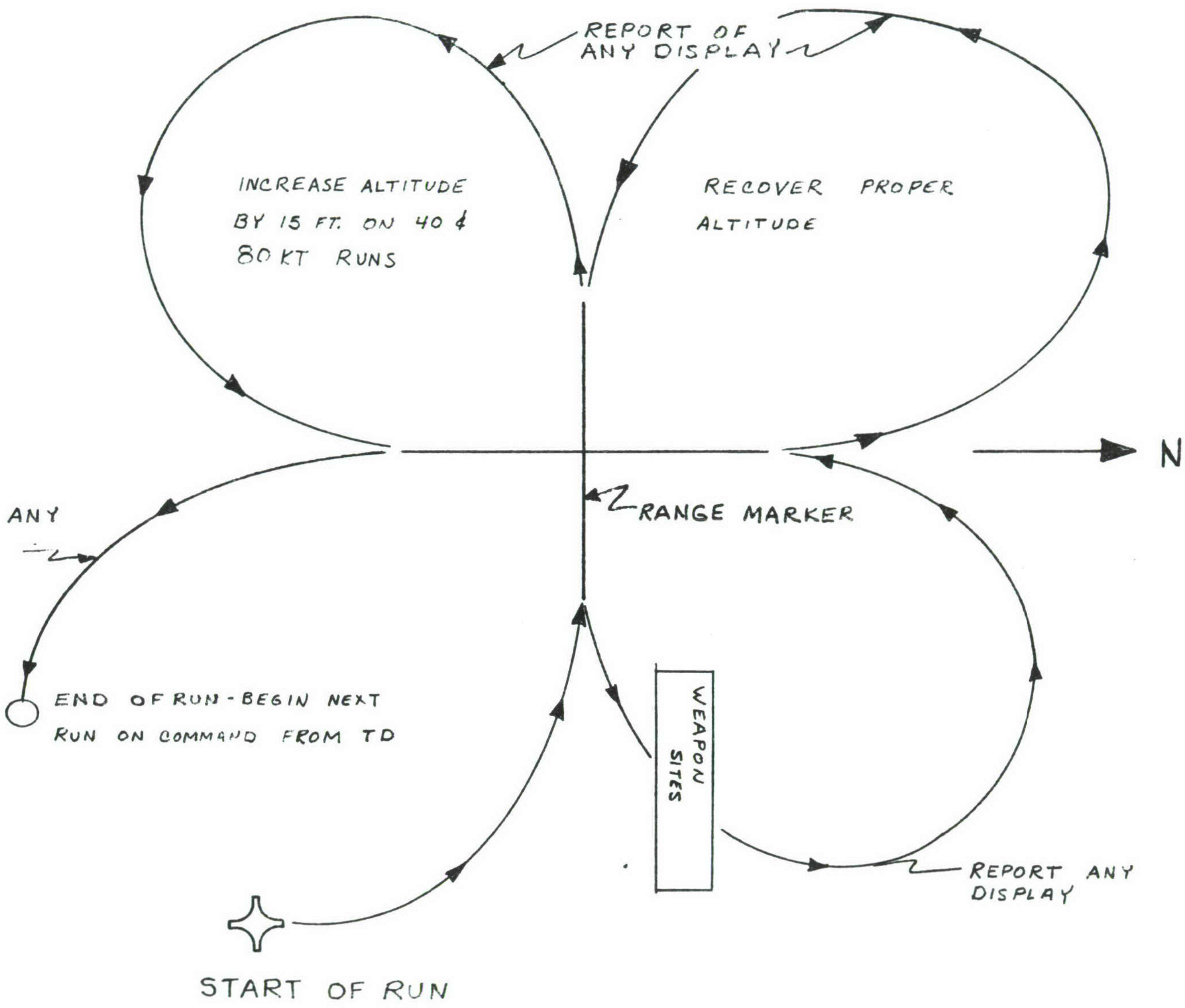

FIGURE 4; CLOVERLEAF FLIGHT PATTERN

Run Number	Weapon Caliber	Elevation Angle at Range					
		500	750	1000	1200	1400	1600
1	22	1.7	1.3	1.0	.8	.7	.5
2	30						
3	50						
4	22						
5	30						
6	50						
7	22						
8	30						
9	50	1.7	1.3	1.0	.8	.7	.5
10	22	5.7	3.9	3.0	2.3	2.1	1.9
11	30						
12	50						
13	22						
14	30						
15	50						
16	22						
17	30						
18	50	5.7	3.9	3.0	2.3	2.1	1.9
19	22	21.8	15.0	11.3	9.5	8.2	7.1
20	30						
21	50						
22	22						
23	30						
24	50						
25	22						
26	30						
27	50	21.8	15.0	11.3	9.5	8.2	7.1
28	22	45.0	34.0	26.7	22.6	19.7	17.3
29	30						
30	50						
31	22						
32	30						
33	50						
34	22						
35	30						
36	50	45.0	34.0	26.7	22.6	19.7	17.3
37	22	63.5	53.3	45.0	40.0	35.8	32.0
38	30						
39	50						
40	22						
41	30						
42	50						
43	22						
44	30						
45	50	63.5	53.3	45.0	40.0	35.8	32.0

Figure 5; ELEVATION ANGLES

TEST BLOCK A
RANGE 750
MISS DISTANCE 100

DATE: ____________

WEATHER: ____________

WIND:

	SPEED	DIRECTION
0800		
1000		
1200		
1400		
1600		

COMMENTS:

TEST DIRECTOR: ____________

PILOT: ____________

GUN CREW: ____________

RUN NO.	FIRE FROM	NO. OF ROUNDS FIRED	AUDIO	NO. OF DOTS ON SCOPE	AZIMUTH	DEPRESSION ANGLE	FALSE ALARM	REMARKS
1	A R F L							
2	A R F L							
3	A R F L							
4	A R F L							
5	A R F L							
6	A R F L							
7	A R F L							
8	A R F L							
9	A R F L							

The data recorder positioned at LS-1, where he is able to monitor both radio nets, will be recording the data from these tests. He will have one page of the form on which will be recorded the data from the 36 tests at one altitude. This will then require 5 pages of data from a block of tests on each day plus any data from special test runs on that day. Since condition of altitude, range, weapon, etc., are to change more frequently for special tests, data recording is less voluminous but more critical. In addition to the data forms already mentioned, it is desirable that another form be completed daily which will privide any opinion and comments from the seven participating personnel. First entry should be by the data recorder where he should note the daily weather conditions including wind direction and velocity, temperature and humidity. At the day's completion, comments should be solicited from the a/c crew, the locator men, the gun crew and especially the test director. These forms are provided in packages with this plan and are noted for each activity. When the sequence to testing varies from the planned, the package must be revised to insure the correct forms are made available to the data recorder. At day's end or periodically, the completed forms should be reproduced and one copy provided to ORI so that data reduction and analysis can begin as soon as possible.

Some of the special tests to be run during the program are as noted below:

Use the UH-1D instead of the UH-1B

Fire multiple shots instead of single rounds

Increase the gross weight of the UH-1B

Firing of special weapons

Firing from multiple positions

Testing of the additional IALS

Flying at 100 knots

Table 1 reveals the particular runs to be made during 5 of these special tests. Separate data collection packages are provided for each test.

TABLE 1

SPECIAL TEST ACTIVITY

Number	Special Condition	Runs	Estimated Completion Time
1	Replace the three basic weapons to be used during the tests with the M-1, 30 cal Mg and the 37 mm.	10-18 of block G 28-36 of block R	1 hr
2	Replace the three basic weapons with the M-1, 12.5 mm and the AK.	19-27 of block N 37-45 of block A	1 hr
3	Use the M-1, 12.5 mm and the AK at Block A firing point. Use the 3 basic weapons at Block R firing point. Fire simultaneously - one weapon from each point.	10-36	1 hr
4	Fire multiple rounds from each weapon.	10-15 and 28-33 of blocks J, H, & Q	1-1/2 hr
5	Make all runs at 100 knots a/c speed.	1, 2, 3, 19, 20, 21 of blocks R & M	1 hr

Due to the amount of equipment to be transported to the range daily, it is required that the range crew have a 3/4-ton truck for their use on test days. In the truck can be mounted the radio set to be used for contact between the Test Director and the aircraft crew. Radios for contact between the firing points and the locator points should be a different net and this communication might be accomplished by means of a "walkie talkie" type set. Dependent upon the type of locating device available, the transit man might need a headset type arrangement in order to free his hands for operation of the device.

To be transported to the range daily in the truck would be the following:

7 people - TD, 2 location men, 1 data recorder, 3-man weapon crew
3 weapons (minimum)
180 rounds of ammo (minimum)
1 field table
2 folding chairs
3 radios - for locator sites and firing point
Lunch?
Data forms for the tests to be run on that day
Equipment for any of the special tests on that day.

One of the seven men might be eliminated by allowing the operation at locator point #1 to be performed by two men instead of three. This could free the test director so that he can move freely between the locator points, the firing points and to ride in the aircraft. The "best" procedure for this should be determined during the pilot tests.

Another alternative for the reduction of personnel would be to eliminate locator point #2 and move locator point #1 to a position SE of the range marker and from here locate the a/c in both the N-S and E-W paths.

Without the use of any locator points, two alternatives are available.

(1) Position a man at the range marker intersection who would locate the a/c merely by sighting him directly overhead and giving the "fire" command, or

(2) Allow the pilot to locate himself over the range marker and calling for fire himself.

If location accuracy of the system is of significance, the first alternative is bad, and if any degree of gaming is desired, alternative 2 is bad. Resources and desired accuracy of the results should dictate which alternative must be used.

APPENDIX A

TEST PLAN RATIONALE

The purpose of this test program is to evaluate the performance of the Improved Acoustic Locator System (IALS) during live firing conditions in order to determine its operational capabilities and limitations.

The IALS was developed in response to a small development requirement (SDR) for a bullet detection device for Army aircraft.[1/] Paragraph 2a of the SDR states the purpose of the development as follows:

> "A device to detect and indicate to aircrews of tactical aircraft the near passage of projectiles, and to indicate the direction from which fire originated in both horizontal and vertical angles from the aircraft."

The operational characteristics of the device are specified in paragraph 2b of the SDR.

1/ Department of the Army Approved Small Development Requirement for a Bullet Detection Device for Army Aircraft (U), 22 October 1965, CONFIDENTIAL.

The test plan described in this report was designed to gather data for use in describing the system performance in terms of (a) probability of detection of ground fire and (b) accuracy of location of the source of the fire as functions of the factors that affect these two parameters. Reference material[2,3] was reviewed and discussions were held with personnel at LWL to identify the factors, and their levels, to be considered in the test design. Table A-1 lists the factors incorporated into the test design and the levels of each factor along with a brief statement of the affect of each factor on system performance and the applicable operating characteristics, if any, specified in the SDR.

Additional factors that do influence the system performance and that are not listed in Table A-1 include the type of terrain over which the aircraft is operating and the depression angle of the source of fire relative to the aircraft. The probability of detection of the reflected ballistic shock (RN) wave and the muzzle blast varies considerably from a wooded to a non-wooded area. This factor was not considered because of the inconvenience of using different test sites. The accuracy of location varies with depression angle. Although not specifically listed in the table, this factor is considered with the different ranges and aircraft altitudes included in the test design.

Six of the factors listed in Table A-1 were included in the factorial design of a set of tests intended to gather data for statistical analysis to describe the probability of detection of ground fire and accuracy of location of its source. To conserve test time, three additional factors are considered in individual tests intended not to gather data for statistical analysis but to describe system performance under these conditions.

2/ J. Wenig and H. Forst, An Airborne Acoustic Locator System (U), U.S. Army Limited War Laboratory Draft Report, CONFIDENTIAL.

3/ U.S. Army Limited War Laboratory, Acoustic Locator System (U), Technical Report LWL-CR-08P3, September 1967, CONFIDENTIAL.

Table A-1. Factors Affecting Performance of the Improved Acoustic Locator System.

Factor	Effects on Probability of Detection (P_D) and/or Accuracy of Location (A_L)	Operational Characteristic from SDR; Essential (E) and/or Desirable (D)	Suggested Levels for Test	Type of Test
Range	Affects probability of detection of RN-wave and MB, hence ability to locate.	Slant range to 1000 ft (E); 3000 ft. (D).	Horizontal ranges of 500, 750, 1000, 1200, 1400, 1600 ft	Factorial Test Design
Miss Distance	Affects probability of detection of N-wave.	To 100 m (E); 300 m (D).	100, 200, 300 ft.	
Aircraft Altitude	Ambient noise is a function of A/C altitude; hence, altitude affects probability of detection of signals.	Slant range, as above, only.	15, 50, 200, 500, 1000 ft,	
Aircraft Speed	Ambient noise is a function of A/C speed, affecting probability of detection of signals. Also, A/C speed effects accuracy of location.	System not to be adversely affected by speed of A/C.	0, 40, 80 kn.	
Weapon	N-wave and RN-wave are a function of weapon and projectile. MB is a function of weapon. Probability of detection of signals is affected by weapon type.	Device to detect projectiles as small as .22 cal.	M-16; M-1, M-14 and .30 cal; AK, 12.5 mm, 37 mm and .50 cal MG.	
Azimuth (Relative to Aircraft)	Because of location of pod on A/C, P_D is affected by azimuth of source relative to A/C.	—	0, 90, 180, 270°.	
Aircraft Type	Ambient noise is a function of A/C type, affecting P_D.	All Army A/C exposed to enemy ground fire.	UH-1B, UH-1D.	Single Demonstrations
Aircraft Load	Ambient noise varies with A/C load, affecting P_D.	—	Unloaded, typical UH-1B load,	
Rate of Fire	Ability of operator to interpret display; hence, A_L, is a function of rate of fire.	Rates up to 17 per second.	Single fire, bursts.	

The schedule and manner of conduct of the factorial tests described in Sections III and IV provide for the collection of large quantities of data in relatively short time periods. The ability of the observer to collect meaningful, accurate data is considered to be the limiting criterion for determining the number of individual tests to be conducted in a unit of time.

The range layout and test procedures group the tests into blocks of 180 data points. Each block of tests can be conducted in an estimated 3 3/4-hr time period. This time period is based on an estimate of 5 minutes for the aircraft to run a pattern of 4 flights, at different azimuths, over a reference point. This 5-minute period is believed to provide sufficient time for the observers to collect data. Each block of tests can be conducted with the gun crews at a single position, varying their weapons, and with the aircraft operating at different aspects, speeds, and altitudes. Range and miss distance are varied from block to block by relocating the gun crew.

Seven different weapons are used during these tests; three weapons are to be used in the factorial tests. The M-16 represents .22 cal.; the M-14 represents the .30 cal.; and the .50 cal. MG represents the third weapon. Special tests are designed to demonstrate the M-1, .30 cal. MG, the AK, the 12.5 mm, and the 37 mm weapon.

Data will be collected on data sheets during the tests for immediate analysis to determine probability of detection and accuracy of location. The signals recorded on magnetic tape are considered to be of use in later detailed analyses.

APPENDIX B
DATA ANALYSIS

Data will be available following the tests from two basic sources:

a. Completed data sheets, with manual entries, will be available for analysis immediately after the testing on a day-by-day basis.

b. Magnetic tape recordings of selected signals from the IALS and audio comments will be made during the tests by the manufacturer. Information from these tape recordings will available for analysis after some delay for data processing.

The data described in the first paragraph above will form the basis for the analysis to be conducted during this work assignment. These data will be supplemented by information from the magnetic tape and film strip recordings, if available, as necessary and primarily for purposes of clarification.

FACTORIAL TESTS

Data resulting from the factorial tests will be used to describe two measures of the system performance:

1. Probability of detection of ground fire, and

2. Accuracy of location of the source of fire,

each in terms of the factors that affect the particular measure. These are seemingly simple measures of performance but are complicated by the different ways in which a detection or a location can be made.

The IALS processes and displays all acoustic waves detected by the three microphones in the receiver array. There are three distince signals associated with a given firing and normally detected by the receiver array. In chronological order, they are the bullet shock wave (N-wave) from the bullet as it passes the aircraft, the reflection (RN-wave) of the bullet shock wave from a point on the ground between the weapon and the aircraft, and the wave from the muzzle blast (MB). If all three signals associated with a firing are detected and displayed by the IALS, the operator can easily distinguish among them. The factor that influences the detection of the N-wave most is probably the miss distance. Range and terrain probably influence most the detection of the RN-wave and the muzzle blast. The test design intentionally creates conditions under which the detection of all three signals are likely and under which the detection of the N-wave alone is likely and the detection of the RN-wave and muzzle blast only are likely.

The SDR describes the device to be developed as one to detect ground fire directed at the aircraft. If one signal is received and displayed by the IALS, the operator cannot identify it in terms of N-wave, RN-wave, or muzzle blast. The system does not necessarily distinguish between the following two cases:

a. Ground fire directed at the aircraft from a long range and resulting in a near miss.

b. Ground fire not directed at the aircraft and occurring at a near range.

For purposes of describing system performance during the data analyses, the sounding of an audio alert, which is concurrent with a display on the CRT, will be interpreted as a detection. During later more detailed analyses, using data from the magnetic tape recordings, the probability of detection of each of the three individual signals can be determined as functions of the different factors influencing system performance.

The MB signal provides the most accurate location information. The RN-wave provides fairly accurate location information. The N-wave indicates no information on location of the source of fire but nevertheless is displayed on the CRT. If after a given firing all three signals are displayed, the operator will read azimuth and depression angles from the MB signal. If two signals are displayed, the second will be interpreted for azimuth and depression angles and, at worst, the RN-wave will be used for location. If only one signal is displayed, the angles will be read from the display for describing location. If the one signal happens to be the N-wave, location accuracy will be quite poor. However, for purposes of describing system performance during the data analyses, the interpretation of the last signal to be received and displayed for location information seems to be most reasonable. During later more detailed analyses, using data from the magnetic tape recordings, the accuracy of location can be determined for the MB signal and the RN-wave individually.

As indicated earlier in this discussion, the data to be analyzed during this work assignment will consist most likely of only that recorded on the data sheets during the actual conduct of the tests. One of the six

factors, probably range, will be considered as the dominant factor. Probability of detection and location accuracy will be graphically portrayed as a function of range.

a. Probability of detection (P_D) will be described as the ratio of the number of audio alerts (or displays) to the number of firings.

b. Accuracy of location (A_L) will be described in terms of each of the angles, considering both biases and the magnitudes of the errors.

The curves of P_D and A_L versus range will be plotted, along with appropriate confidence intervals, on what will be considered base charts. For each of the remaining 5 parameters, a family of curves of P_D versus range and A_L versus range will be plotted on a transparency that can be overlaid on the base chart to enable a quick graphical analysis of the levels of each additional factor that cause significant differences from the basic values. More detailed factorial analyses will then be conducted as individual cases, as appear necessary.

DEMONSTRATIONS

The special tests for assessing the influence of aircraft type, aircraft load, and rate of fire on system performance will be analyzed on an individual basis for the levels of range and miss distance selected. Under these conditions, P_D and A_L will be compared with the values from the factorial tests to determine significant differences.

APPENDIX C

This appendix is a copy of the work assignment which originated the contractor effort in the testing and analysis of the ALS.

WORK ASSIGNMENT

TITLE: Evaluation of an Acoustic Locator System, Task 08-P-63

1. Work Assignment Number: 6

2. Contract Number: DAAD05-68-C-0119

3. Background: The U. S. Army Limited War Laboratory has developed a device, known as the Acoustic Locator System, for use aboard Army aircraft to detect ground fire directed at the aircraft and to locate the source of the fire. The system measures the transit time of an acoustic wave across a three-microphone array mounted on the exterior of the aircraft, alerts the aircrew to the ground fire, processes the signals from the microphone to obtain azimuth and depression angles of the source relative to the aircraft, and displays the location information on a cathode ray tube inside the aircraft

Six Acoustic Locator Systems were tested under live firing conditions at Aberdeen Proving Ground during January 1967. These same systems were then sent to Vietnam for evaluation under combat conditions. Tests and combat usage have proven the acoustic detection and location concept to be sound. Problem areas were identified and an Improved Acoustic Locator System (IALS) has been designed. Improved systems are presently being fabricated and will be available for testing at Aberdeen Proving Ground during the period 1 July to 15 August 1968.

4. Objective: To develop a test plan by which the IALS can be evaluated, to indicate a method for data analysis and to reduce and analyze the data.

5. Services to be Performed: The contractor shall study the principle and operating characteristics of the IALS, identify the factors that influence its performance, and devise a test plan for evaluation of the system aboard the UH-1B and UH-1D aircraft during live firings and reduce and analyze the data. The tests will be designed primarily to evaluate the detection capability and location accuracy of the IALS under different operating conditions. The optimization of the read-out devices and the false alarm rates and causes will be secondary considerations.

The test plan will be designed for two levels of testing. The first level will be the detailed testing of at least one system to determine the capabilities and limitations of the IALS aboard each of the two types of aircraft. The second level will be an acceptance test for verifying the operation of each additional system.

Within the constraints of available facilities, time, and money, the test plan will be designed to allow the collection of as much data as possible for evaluation of the system. The constraints are:

a. Facilities: Those available to the Limited War Laboratory at Aberdeen Proving Ground.

b. Time: System will be available for testing during the period 1 July to 15 August 1968, however, due to problems in aircraft and range scheduling and inclement weather, the tests should be designed for conduct within a three-week period.

c. Costs: Total costs of the tests should not exceed $20,000.

During the tests, data will be collected in the form of manual entries in logs from visual readout devices and magnetic tape recordings of signals, from the system sensors and electronic processing unit.

The test plan and the methods to be used in tabulating and analyzing the collected data shall be included as an appendix to the final report.

6. Testing Requirements: None

7. Items to be Delivered: The contractor shall submit the following written reports during performance of the work assignment.

a. Monthly Letter Report

b. Draft of Test Plan within two weeks after acceptance of work assignment.

c. Final Proposed Test Plan within one week after approval of the draft plan.

e. Final Work Assignment Report.

The Monthly Letter Reports and Final Work Assignment Report shall be prepared and distributed pursuant to instructions set forth in paragraph 4, Exhibit "A", Scope of Work, of basic contract.

8. Government Furnished Property and/or Assistance:

The Government will furnish the following reference materials to the contractor.

a. Extracts from "Department of the Army Approved Small Development Requirement (SDR) for a Bullet Detection Device for Army Aircraft (U)," dated 22 October 1965, classified CONFIDENTIAL.

b. LWL Draft Report, "An Airborne Acoustic Locator System," by J. Wenig and H. Forst, classified CONFIDENTIAL.

c. Technical Report No. LWL-CR-08P3, "Acoustic Locator System (U)," dated September 1967, classified CONFIDENTIAL.

9. Estimated Cost:

The total cost of this work assignment is estimated to be $8,000.00.

10. Estimated Completion Date:

Provided tests are not delayed, this work assignment will be completed within three (3) months after date of its acceptance by the contractor.

11. Technical Supervisor:

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APPENDIX B

TEST OF THE IMPROVED ACOUSTIC LOCATORY SYSTEM ON THE COBRA (AH-1G) AIRCRAFT

APPENDIX B

TEST OF THE IMPROVED ACOUSTIC LOCATOR SYSTEMS ON THE COBRA (AH-1G) AIRCRAFT

Background: During mid 1968, it became apparent that the need for the Acoustic Locator System for the UH-1 aircraft had diminished since the Cobra aircraft had been introduced into Vietnam and the UH-1 was relegated to non-combat jobs and thus was exposed to less and less ground fire. The Cobra gun ship had become the major aircraft subject to ground fire.

Experimentation: Experimentation was performed to determine the best location for mounting the existing UH-1 type Acoustic Locator System on the Cobra aircraft. The pod of the Acoustic Locator System is the most critical element and must be mounted in such a position that smooth, non-turbulent airflow is obtained over the microphones. Various mounting locations on the Cobra were tried: (1) an outboard position, off the skids; (2) underneath the Cobra, behind the gun turret; and (3) a position on the nose of the aircraft. After noise measurements and "wool-tuft" (wind flow) tests, it was concluded that the nose mounting (shown in Figure B-1) was the least noisy and provided the smoothest airflow condition. From the data obtained, a noise match filter for the Cobra was inserted in the Acoustic Locatory System. The system, along with a tape recorder for recording signals, was mounted in the Cobra as shown in Figures B-2 and B-3.

Test Procedures: On 9 and 10 December 1968, acceptance tests, as discussed in Appendix A, were run on the Cobra-mounted Acoustic Locator System while flying the test course. On 16 December, several tests were run in which weapons systems mounted aboard the Cobra were fired. The weapons tested included the turret-mounted mini-gun, the turret-mounted 40mm grenade launcher, and the 2.7 wing-mounted rockets.

Results: The results of the acceptance tests using the M14 rifle are shown in Figure B-4 and Table B-1 and B-2. These indicate that the probability of detecting one or more signals is about as good for the Cobra as it is for the UH-1. However, the number of shots with an azimuth error less than 30^o (this relates to the number of muzzle blasts detected and, hence, the location capability) is shown to be considerable less than was obtained in the UH-1. The false alarm rate for the system mounted on the Cobra was many times greater than that with the UH-1. Table B-3 tabulates the false alarm rates from the tape records for the Cobra. The UH-1 rate was so low that similar data was not obtained. This higher rate with the Cobra resulted from several causes: (1) the exposed mounting position of the pod which did not allow the body of the aircraft to shield the microphones from the downwash; (2) the increased wind noise resulting from the higher speeds possible in the Cobra aircraft; and (3) the greater incidence of rotor pop which comes from the combination of both the increased engine power and the exposure of the pod.

The firing of the turret-mounted weapons on the aircraft produced indications on the system which appeared toward the rear of the display (the proper direction as seen from the pod). As the weapons were swept, these indications moved in azimuth with the weapons. The mini-gun provided indications on just

about every firing while the 40mm grenade launcher seldom gave signals. The firing of the wing-mounted rockets did not cause the Acoustic Locator System to display. The firing of the weapons, approximately two feet from the microphones, damaged one of the three microphones.

Upon examination by the manufacturer, it was concluded that the damage was not the type that should have resulted from overdriving the microphone accoustically. Thus, it is concluded that the microphones themselves were able to withstand these strong shock waves.

Conclusion: The high incidence of false alarms coupled with the low pointing-accuracy makes the present system unsuitable for use on the Cobra.

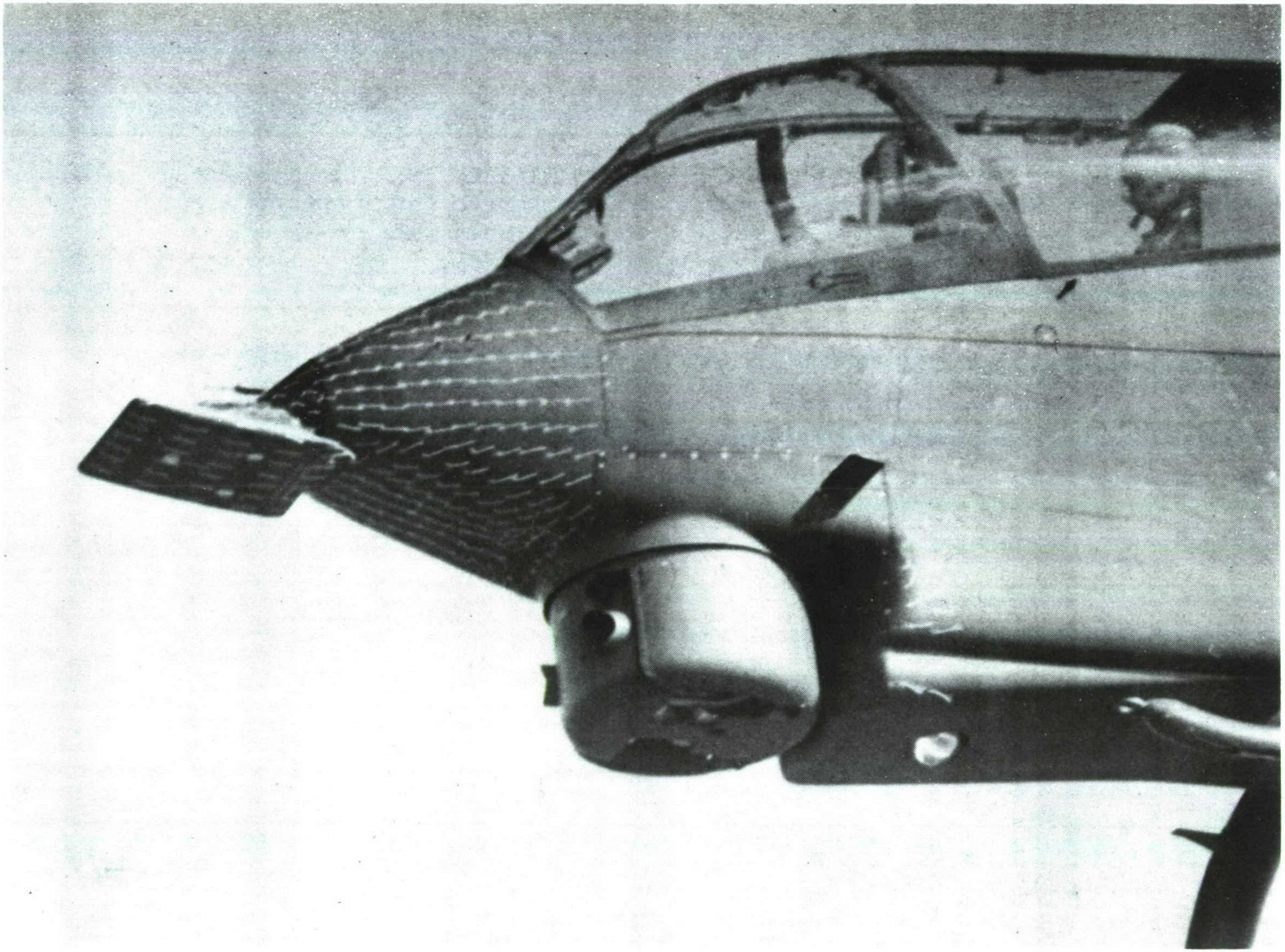


Figure B-1. "Wool Tuft" tests with the Acoustic Locator System's pod mounted on the Cobra to monitor the air flow pattern. This picture was taken at 100 knots airspeed.

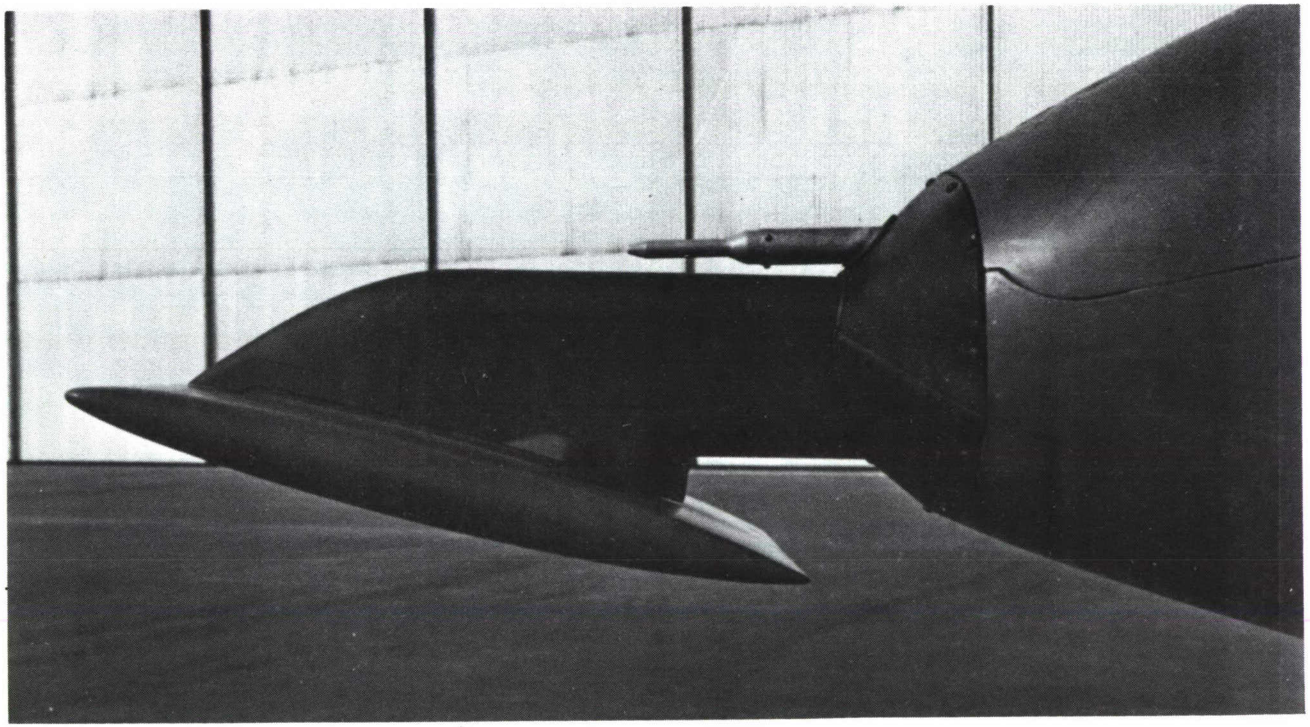


Figure B-2. The Acoustic Locator System's pod mounted on the nose of the Cobra.

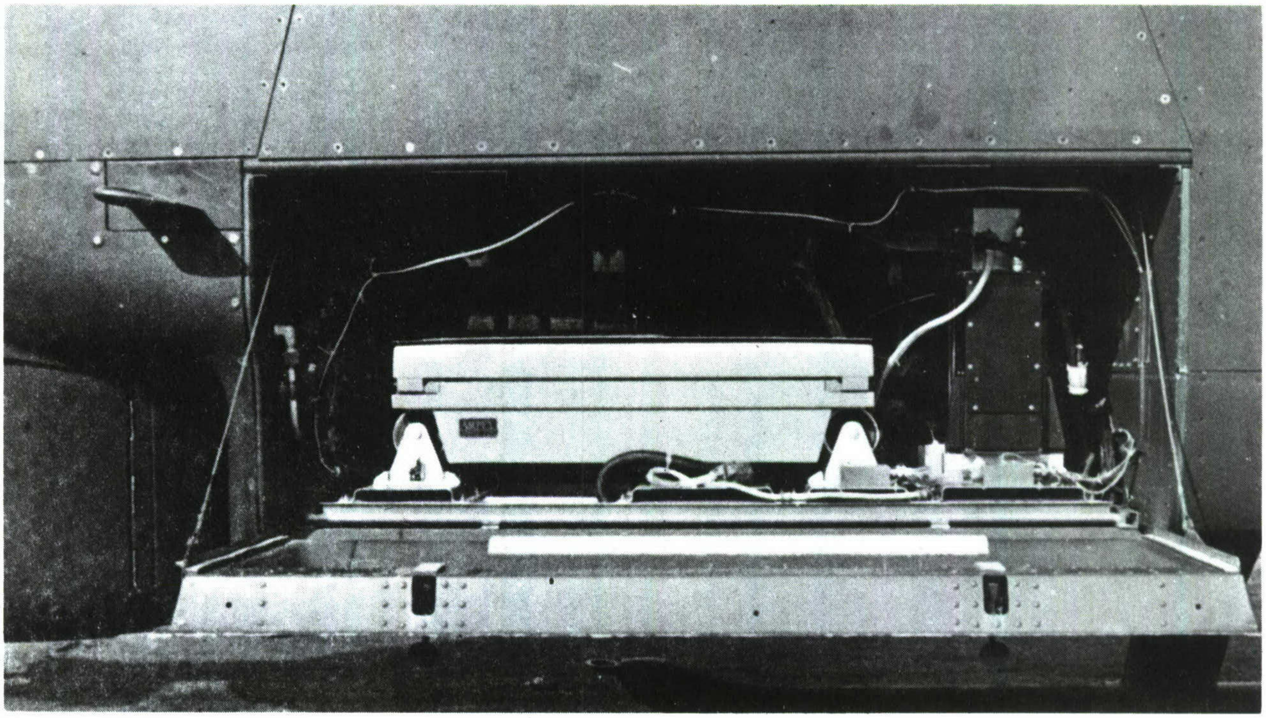
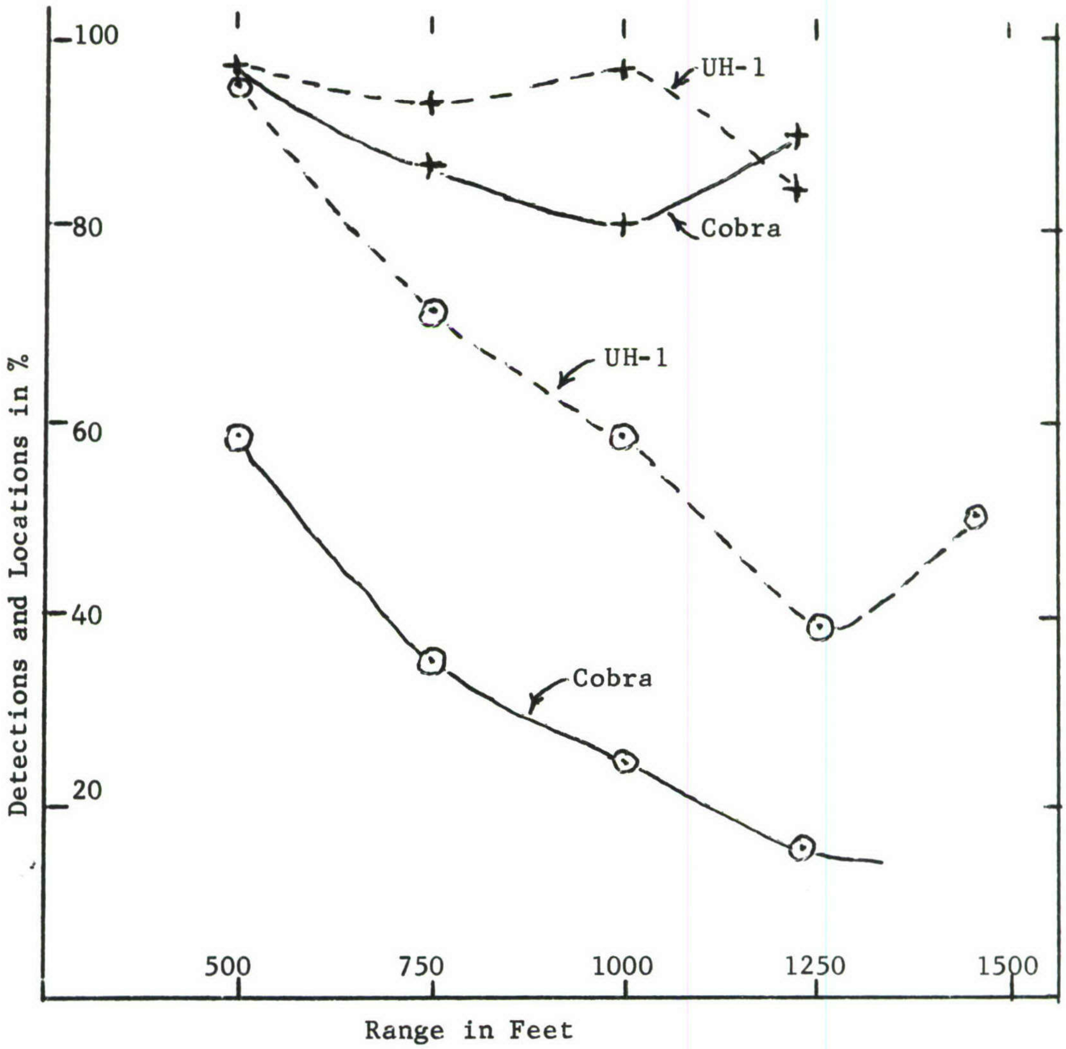


Figure B-3. The Electronics Box and data recorder mounted in the ammunition bay of the Cobra.



+ = Probability of Detecting one or more signals
⊙ = Probability of correct locations (azimuth error less than 30°)
All data is for the M-14 with a miss distance of 100 feet.
The UH-1 data is from Appendix A, either Fig.2 or Fig. 4.

Figure B-4. M-14 per cent detections and percent locations (azimuth error less than 30°) for the Acoustic Locator System on the Cobra and UH-1 aircrafts.

TABLE B-1. M-14, COBRA SUMMARY OF SIGNALS DETECTED

Range	Zero Detection	Number of Shots Displayed With: 1 Det.	2 Det.	3 or More Det.
500	1	5	14	12
750	4	7	13	7
1000	6	9	12	5
1200	3	7	16	5

See Appendix A, page 14 for similar UH-1 data

TABLE B-2. M-14, COBRA. MUZZLE BLAST SIGNALS RECEIVED

(i.e., those signals within 30° of their "should be" position in azimuth and greater than 40° elevation and two or more signals received)

Altitude	Speed	Number of Muzzled Blasts Received/Number Fired Range 500	750	1000	1200
50	20	2/4	1/3	0/4	2/4
50	80	3/4	2/4	0/4	1/3
50	120	2/4	2/4	1/4	0/4
50	160	1/4	1/4	0/4	0/4
200	20	4/4	3/4	1/4	0/4
200	80	4/4	1/4	3/4	1/4
200	120	2/2	1/4	2/4	1/4
200	160	1/4	0/4	1/4	0/4
Total		19/32=.59	11/31=.35	8/32=.25	5/31=.16

See Appendix A, page 15 for similar UH-1 data

TABLE B-3. FALSE ALARM RATE, IN FALSE ALARMS PER SECOND, AS A FUNCTION OF THE PARAMETERS

Range	Attitude	Speed	False Alarm Rate	No. Sec. for Observation
	50	20	no data	
500'	50'	80	.05	40
	50	120	.31	190
	50	160	.04	100
	200'	20	.083	120
	200	80	.01	100
	200	120	.01	100
	200	160	.012	78
750'	50	20	no data	
	50	80	no data	
	50	120	.26	57
	50	160	.01	102
	200	20	.088	90
	200	80	.07	96
	200	120	.03	100
	200	160	.012	163
1000'	50	20	.08	104
	50	80	.03	106
	50	120	.01	103
	50	160	zero	66
	200'	20	.29	180
	200	80	.02	102
	200	120	.013	120
	200	160	zero	80
1200	50	20	.055	90
	50	80	.32	73
	50	120	.38	110
	50	160	.03	160
	200	20	.167	72
	200	80	.047	43
	200	120	.12	50
	200	160	no data	

Average rate = .098 false alarms/second

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